



Project Status Report

High End Computing Capability Strategic Capabilities Assets Program

July 10, 2015

Dr. Rupak Biswas – Project Manager
NASA Ames Research Center, Moffett Field, CA
Rupak.Biswas@nasa.gov
(650) 604-4411

NAS Annual Maintenance Enhances Facility Efficiency and Reliability



- HECC facilities engineers planned, coordinated, and conducted the annual N258 building maintenance, which included numerous repairs and maintenance of key components of the facility.
- Activities completed during the maintenance include:
 - Cleaned the cooling tower.
 - Cleaned the building cooling system chillers.
 - Cleaned the computer room sub-floor.
 - Cleaned and tested all power switch gear and circuit breakers.
 - Tested all fire suppression systems.
 - Fixed/replaced belts, filters, and motors on 17 computer room air handlers.
 - Monitored building power during the LINPACK benchmark run (see slide 5).
- Through advanced planning and close coordination with other groups, the Facilities team ensured that the building returned to full operation with minimal impact to users.

Mission Impact: The NASA Advanced Supercomputing (NAS) facility houses the largest high-end computing resource for NASA and, as such, is an extremely important building to keep running at peak efficiency. Proactively identifying and maintaining the power, cooling, network, and compute hardware greatly reduces the risk of building failures.



The NASA Advanced Supercomputing facility (building N258) at NASA Ames Research Center.

POCs: Chris Buchanan, chris.buchanan@nasa.gov, (650) 604-4308,
Chris Tanner, christopher.tanner@nasa.gov, (650) 604-6754,
NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Resource Maintenance Improves System Performance and Stability



- HECC engineers performed maintenance on the Pleiades supercomputer and the Lou archival storage system to improve stability and enhance performance on the systems. Work included:
 - Updated the InfiniBand (IB) firmware on the switches and cards that support a 2k Maximum Transmission Unit (MTU) packet size. This change provides more flexibility with Quality of Service on the IB network, and will result in fewer network issues on Pleiades.
 - Ran the LINPACK and High Performance Conjugate Gradient (HPCG) benchmarks on Pleiades to identify marginal components in the system. During the maintenance period, over 80 components were identified and replaced on the system. (See slide 5)
 - Updated the power rails on one of the tape libraries that was seeing frequent failures due to electrical issues, in order to improve the reliability of the subsystem.
- Other activities included patching the system for security updates, running filesystem integrity checks, updating the Lustre version to 2.5.3, and updating RAID firmware.

Mission Impact: Regular maintenance on the HECC systems provides a stable and well performing system for NASA users.



Pleiades was in a maintenance window from June 1–9, which provided HECC engineers an opportunity to perform maintenance on the system that could not be provided live on the system.

POCs: Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing Division; Davin Chan, davin.chan@nasa.gov, (650) 604-3613, NASA Advanced Supercomputing Division, Computer Sciences Corp.

New Power Distribution Architecture Improves Protection of User Data



- HECC facilities engineers planned, designed, and implemented a new power distribution architecture for the main computer room in building N258 to provide uninterruptible power supply (UPS) protection for HECC filesystems.
- The power load that is protected by the Rotary Uninterruptible Power Supply (RUPS) was reapportioned to limit the load to a draw that does not exceed the capacity of two of the RUPS. We are now in line with the manufacturers recommendation of running in an N+1 configuration.
- The Facilities team worked closely with the Systems team to identify hardware that needed to move from unprotected power to UPS power protection.
- This new configuration vastly improves HECC's ability to protect user data should building power or RUPS failures occur.

Mission Impact: Scientific data is one of the most important NASA assets. The improvements implemented by HECC facilities experts greatly reduces the risk of lost scientific data during a power failure of the NASA Advanced Supercomputing facility.



The High End Computing Capability project's Rotary Uninterruptible Power Supply located at the NASA Advanced Supercomputing (NAS) facility at NASA Ames.

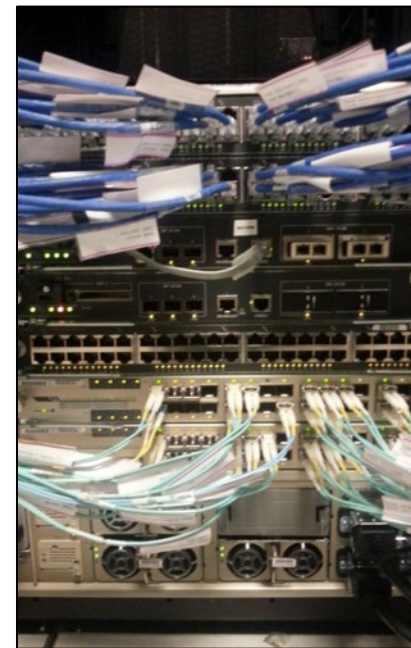
POCs: Chris Buchanan, chris.buchanan@nasa.gov, (650) 604-4308, Chris Tanner, christopher.tanner@nasa.gov, (650) 604-6754, NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Network Upgrades Improve Performance and Future Scalability



- Network engineers completed an upgrade of the NAS high-speed network (NASLAN) border and DMZ routers with the addition of new 32-port 1 and 10 gigabit (1/10G) modules, which increased the 10G port density by 400%.
- The new 1/10G line cards can (with a purchase of adapters) support both 40G and wide area network (WAN)-optimized port buffers that improve the performance of file transfers.
- Additionally, engineers upgraded the HECC enclave border router and the main public enclave switch to the Cisco Catalyst 6800. Benefits of the new hardware:
 - Supported by a mature (15+ years), stable IOS software.
 - Integrates easily with existing tools for management.
 - Allows for future port scalability using Instant Access (IA) technology.
- The network team worked with the NASA Integrated Communication Services (NICS) team to bring NAS WAN connectivity in alignment with the Homeland Security Trusted Internet Connections (TIC) 2.0 requirements.

Mission Impact: The capabilities of the new border and DMZ routers provide increased network capacity to meet the ever-growing demands of the remote HECC user community.



The High End Computing Capability project's new enclave main public switch with 1-gigabit and 10-gigabit connections.

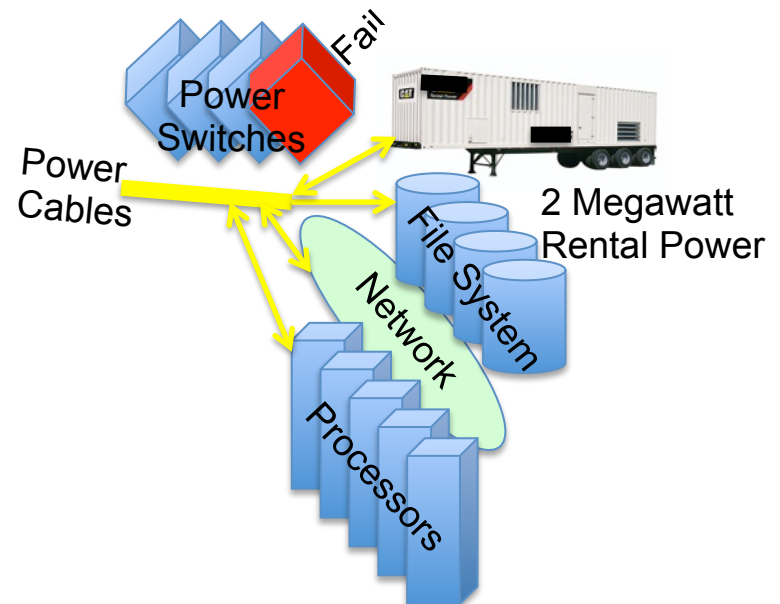
POCs: Nichole Boscia, nichole.k.boscia@nasa.gov, (650) 604-0891, Harjot Sidhu, harjot.s.sidhu@nasa.gov, (650) 604-4935, NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Successfully Completes Annual Functional Test of NAS Contingency Plan



- NAS staff completed the required annual testing of the NAS Contingency plan using a functional-test approach in which NAS groups responded in real-time to a hypothetical scenario.
- The functional test involved a surprise notification that one of the switches powering a significant portion the HECC computers and disks had a hypothetical failure with a three-week estimate to repair.
- Meetings were held with NAS staff soon after the Contingency Plan Coordinator was informed of the failure to work out a strategy to get the NAS systems back online.
- Within a few hours, a solution was devised to bring in a power generator that would provide half of the lost power.
- By the next day, a generator was located within the Bay Area that would replace all of the lost power until the switch could be repaired.
- Under the direction of the Contingency Plan Coordinator, the NAS team worked efficiently to demonstrate again that they could meet even a significant hypothetical challenge such as this.

Mission Impact: Successful completion of NASA's annual contingency plan test will help the HECC project maintain its authorization to operate agency supercomputing resources.



This figure shows how a failed red power switch was hypothetically replaced with a 2-megawatt portable diesel power generator, to rapidly get High End Computing Capability project systems back into operation in the face of a hypothetical contingency situation.

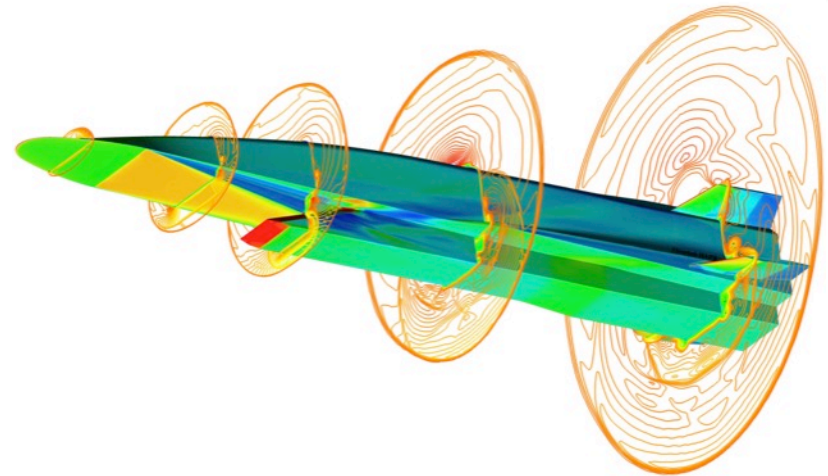
Thomas Hinke, thomas.h.hinke@nasa.gov, (650) 604-3662, NASA
Advanced Supercomputing Division

HECC Supports Optimization of Langley VULCAN Hypersonic Code



- HECC Application Performance and Productivity (APP) staff recently started a long-term collaboration with several application groups at Langley Research Center (LaRC) to improve user self-sufficiency in analyzing and improving the performance of their codes.
- Initially, APP staff are doing the analysis and optimization and then conducting WebEx sessions to explain their work in detail to the application teams. After studying the first code—Viscous Upwind Algorithm for Complex Flow Analysis (VULCAN)—APP staff obtained a 46% performance improvement:
 - Used targeted inlining of routines vs. universal inlining.
 - Had compiler replace some divisions with multiplications and use longer vector registers to execute compute-intensive loops.
 - Recoded several routines to avoid expensive intrinsic function calls.
 - Recoded the calculation of enthalpy and specific heat at constant pressure to eliminate use of an index array.
 - Used the PageCache management utility to avoid remote memory accesses.
- As the LaRC staff become comfortable with the tools and techniques being used, they will gradually become more adept with analysis and optimization and less reliant on APP staff for help. The experience will also help them design and develop codes suitable for modern high-end computing systems.

Mission Impact: In addition to the direct benefits of faster, more efficient codes, the collaborative effort is producing a knowledgeable core of users at Langley Research Center who will be more independent and able to help others, as well.



The Viscous Upwind Algorithm for Complex Flow Analysis (VULCAN) is a computational fluid dynamics code primarily developed by members of Langley Research Center's Hypersonic Airbreathing Propulsion Branch to aid in the development of Supersonic Combustion Ramjet engines. This image shows surface pressure contours and cross-sections of Mach contours extracted from a Reynolds-averaged simulation of the flow around a Boeing X-51 scramjet flight demonstration aircraft.

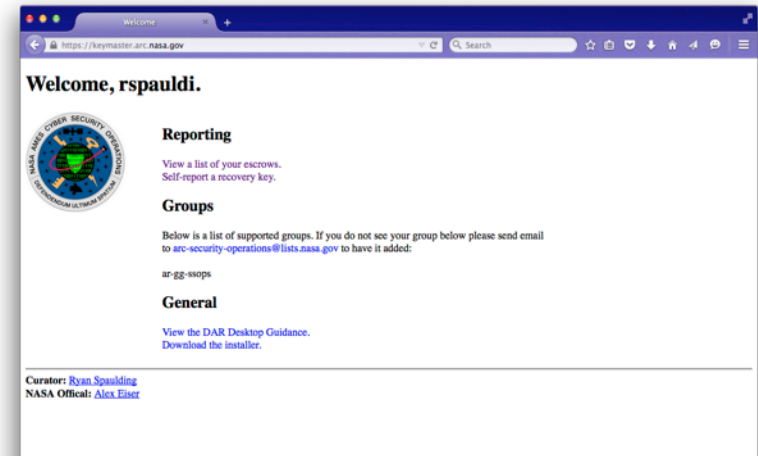
POCs: Dan Kokron, daniel.kokron@nasa.gov, Robert Hood, robert.hood@nasa.gov, NASA Advanced Supercomputing Division, Computer Sciences Corp.

HECC Helps Ames Improve End-User System Security of Encryption Key Escrow



- The HECC Tools team, working with the Ames Research Center (ARC) Security team, added group support (along with several other enhancements) to the ARC encryption escrow server, called KeyMaster. KeyMaster allows system administrators to escrow encryption keys created during full laptop encryption.
- Additionally, the KeyMaster website allows any Ames employee to escrow passwords or keys safely and securely for later use. The list of changes to the KeyMaster website and desktop client include:
 - Mac OS X KeyMaster client now accepts group membership requests. When keys are escrowed, users are presented with a list of groups they are members of. Assigning a key to a group is optional. When enabled for groups, individual users will be able to see/escrow/recover keys from other group members. The entire group will be emailed when a key recovery occurs.
 - KeyMaster Server now supports key deletion. The owner and all group members are emailed when a key is deleted.
 - OS X KeyMaster client was updated for improved support on OS X 10.9 and OS X 10.10.
 - New KeyMaster administrator tools to migrate existing escrowed keys to be grouped owned.
 - New KeyMaster administrator tools to add and remove users from Active Directory groups.

Mission Impact: Desktop support teams at the NASA Advanced Supercomputing facility and NASA Ames can now share escrowed keys (used for laptop encryption) with team members, without having to go through a KeyMaster administrator.



Screen shot of the KeyMaster web interface. Once logged into KeyMaster, users have access to any escrowed encryption keys that are owned by members of their group.

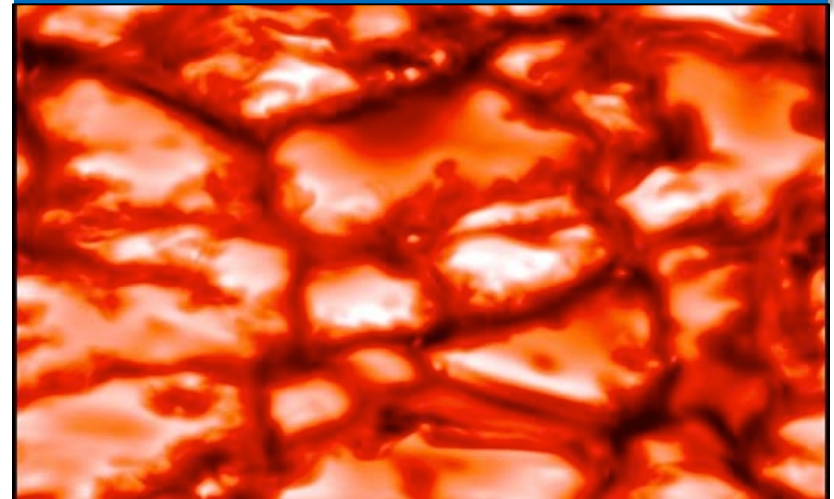
POC: Ryan Spaulding, ryan.c.spaulding@nasa.gov, (408) 772-6567, NASA Advanced Supercomputing (NAS) Division, Adnet

Realistic Simulations of the Solar Radiation Spectrum Enable Analysis of HMI Data



- The Helioseismic and Magnetic Imager (HMI) instrument aboard NASA's Solar Dynamics Observatory (SDO) continuously acquires near-real-time images of the full solar disk. Scientists at NASA Ames create realistic 3D simulations of the HMI optical path to reproduce how the instrument “sees” the data.
- These “synthetic observations” enable researchers to investigate, interpret, calibrate, and explain various effects observed by the HMI. For example:
 - Reproduce the “concave Sun” mystery—an effect observed when the solar oscillation signal from the near-limb regions arrives faster than from the solar disk center.
 - Confirm our understanding of this effect, provide quantitative data for instrument calibration, and help to improve the accuracy of helioseismology measurements of subsurface flows on global scales.
 - Allow researchers to investigate important observations of solar phenomena, such as the formation of the Sun's magnetic structures, eruptions, and subsurface dynamics by taking into account the conditions that the emitted light encounters on the way to the detectors on HMI.
- Realistic simulations of the turbulent convection of the Sun are not possible without substantial computational and data storage resources. For this project, researchers used up to 8,000 processors on Pleiades, and more than 200 terabytes of storage.

Mission Impact: The advanced computational capabilities of NASA's Pleiades supercomputer enable researchers to generate the massive amounts of data needed to create a facsimile of the Sun, and to analyze it as the HMI instrument on the SDO satellite observes it.



Simulated continuum intensity image of the iron line observed by the Helioseismic and Magnetic Imager for an area located at 45 degrees from the solar disk center. Individual patterns on the image represent upflows (granules) with characteristic size of 1,000 – 2,000 km. Dark lanes between the upflows correspond to downflows. *Irina Kitiashvili, Alan Wray, NASA/Ames*

POCs: Irina Kitiashvili, irina.n.kitiashvili@nasa.gov, (650) 604-1447,
Alan Wray, alan.a.wray@nasa.gov, (650) 604-6066, NASA
Advanced Supercomputing Division

** HECC provided supercomputing resources and services in support of this work*

HECC Facility Hosts Several Visitors and Tours in June 2015



- HECC hosted 12 tour groups in June; guests learned about the agency-wide missions being supported by HECC assets, and some of the groups also viewed the D-Wave Two quantum computer system. Among the guests this month:
 - Thomas Christian, Director of the Air Force Office of Scientific Research.
 - Fr. Dr. Jose Funes, Director, Vatican Observatory.
 - James Der Derian, Director of the Centre for International Security Studies, University of Sydney, Australia, and a team producing a documentary on quantum theory, under a grant from the Carnegie Corp. The team interviewed Eleanor Rieffel and Rupak Biswas.
 - Jim Lujan, HPC Project Leader at Los Alamos National Laboratory.
 - Brenton Bennett, Australian Defence Science and Technology Organisation (DSTO)
 - Robert Ferencz, Division Leader for Computational Engineering at Lawrence Livermore National Laboratory (LLNL), and several LLNL computer engineers and data scientists.
 - Members of NASA Supervisory Development Program
 - Technical teams from Mellanox and Yahoo



NASA Advanced Supercomputing (NAS) Division, Chief Piyush Mehrotra, shows results of modeling and simulation projects to visitors.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputing Division



- **“Instability of Current Sheets with a Localized Accumulation of Magnetic Flux,”** P. Pritchett, Physics of Plasmas, vol. 22, June 2, 2015. *
<http://scitation.aip.org/content/aip/journal/pop/22/6/10.1063/1.4921666>
- **“On the Diffuse Ly α Halo Around Ly α Emitting Galaxies,”** E. Lake, Z. Zheng, R. Cen, R. Sadoun, R. Momose, M. Ouchi, The Astrophysical Journal, vol. 806, no. 1, June 10, 2015.*
<http://iopscience.iop.org/0004-637X/806/1/46>
- **“Disks and Jets,”** J. Hawley, et al., Space Science Reviews (Springer), June 19, 2015. *
<http://link.springer.com/article/10.1007/s11214-015-0174-7>
- **“Jumping Neptune Can Explain the Kuiper Belt Kernal,”** D. Nesvorny, arXiv: 1506.06019 [astro-ph.EP], June 19, 2015. *
<http://arxiv.org/abs/1506.06019>
- **“From Engine to Afterglow: Collapsars Naturally Produce Top-Heavy Jets and Early-Time Plateaus in Gamma-Ray Burst Afterglows,”** P. Duffell, A. MacFadyen, The Astrophysical Journal, vol. 806, no. 2, June 20, 2015. *
<http://iopscience.iop.org/0004-637X/806/2/205>
- **“A Priori Analysis of a Compressible Flamelet Model using RANS Data for a Dual-Mode Scramjet Combustor,”** J. Quinlan, T. Drozda, J. McDaniel, G. Lacaze, J. Oefelein, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/abs/10.2514/6.2015-3208>

* HECC provided supercomputing resources and services in support of this work

Papers (cont.)



- **“Computational Approaches to Simulation and Optimization of Global Aircraft Trajectories,”** H. Ng, B. Sridhar, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/abs/10.2514/6.2015-2279>
- **“Time-Accurate Unsteady Pressure Loads Simulated for the Space Launch System at Wind Tunnel Conditions,”** S. Alter, G. Brauckmann, B. Kleb, C. Glass, G. Street, D. Schuster, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/10.2514/6.2015-3149>
- **“Numerical Simulation of a Scramjet Isolator with Thermodynamic Nonequilibrium,”** R. Fievet, H. Koo, V. Raman, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/10.2514/6.2015-3418>
- **“Arc Jet Facility Test Condition Predictions Using the ADSI Code,”** G. Palmer, D. Prabhu, I. Terrazas-Salinas, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/10.2514/6.2015-2663>
- **“LagRST Model Predictions of a Wingtip Vortex Flowfield,”** M. Olsen, presented at the 2015 AIAA Aviation Forum, Dallas, TX, June 22-26, 2015. *
<http://arc.aiaa.org/doi/10.2514/6.2015-2923>

** HECC provided supercomputing resources and services in support of this work*

Papers (cont.)



- **“The Ability of Atmospheric Data to Resolve Discrepancies in Wetland Methane Estimates Over North America,”** S. Miller, et al., Biosciences Discussions, vol. 12, June 23, 2015.*
<http://www.biogeosciences-discuss.net/12/9341/2015/bgd-12-9341-2015.pdf>
- **“Direct Numerical Simulation, Theories and Modeling of Wall Turbulence with a Range of Pressure Gradients,”** G. Coleman, A. Garbaruk, P. Spalart, Flow, Turbulence and Combustion (Springer), June 25, 2015. *
<http://link.springer.com/article/10.1007/s10494-015-9621-5>

** HECC provided supercomputing resources and services in support of this work*



- **2015 AIAA Aviation and Aeronautics Forum, Dallas, Texas, June 22–26, 2015.**
 - **“High Order Numerical Methods for the Dynamic SGS Model of Turbulent Flows with Shocks,”** D. Kotov, H. Yee, A. Wray, B. Sjogreen.
<http://arc.aiaa.org/doi/10.2514/6.2015-2297>
 - **“Development of a Spectral-Element Approach for the Eikonal Equation,”** S. Murman, L. Diosady.
<http://arc.aiaa.org/doi/10.2514/6.2015-2285>
 - **“Numerical Simulations of Shock/Plume Interaction Using Structured Overset Grids,”** J. Housman, C. Kiris. *
<http://arc.aiaa.org/doi/10.2514/6.2015-2262>
 - **“Noise Characteristics of a Four-Jet Impingement Device Inside a Broadband Engine Noise Simulator,”** C. Brehm, J. Housman, C. Kiris, F. Hutcheson. *
<http://arc.aiaa.org/doi/10.2514/6.2015-2211>
 - **“Viscous Flow Simulations of a Wing with Variable Camber Continuous Trailing Edge Flap as High-Lift Configuration,”** H. Akaydin, S. Moini-Yekta, J. Jensen, J. Housman, N. Nguyen, C. Kiris.
 - **“PANS Simulations of Turbulent Separated Flow Over a Wall-Mounted Hump”** D. Higuera Caubilla, P. Razi, S. Sehkar, N. Mansour, S. Girimaji.
<http://arc.aiaa.org/doi/10.2514/6.2015-2463>
 - **“A 3-D Computational Study of a Variable Camber Continuous Trailing Edge Flap (VCCTEF) Spanwise Segment,”** U. Kaul, N. Nguyen.
<http://arc.aiaa.org/doi/10.2514/6.2015-2422>



- **2015 AIAA Aviation and Aeronautics Forum (cont.)**
 - **“Use of a Viscous Flow Simulation Code for Static Aeroelastic Analysis of a Wing at High-Lift Conditions,”** H. Akaydin, S. Moini-Yekta, J. Housman, N. Nguyen. *
**<http://arc.aiaa.org/doi/10.2514/6.2015-2418>*
 - **“Simulations of Incompressible Separated Turbulent Flows Around Two-Dimensional Bodies with URANS Models in OpenFOAM,”** A. Porteous, R. Habbit, J. Colmenares, S. Poroseva, S. Murman. *
<http://arc.aiaa.org/doi/abs/10.2514/6.2015-2609>
 - **“Effect of Turbulence Modeling on Hovering Rotor Flows,”** S. Yoon, N. Chaderjian, T. Pulliam, T. Holst. *
<http://arc.aiaa.org/doi/10.2514/6.2015-2766>
 - **“General Element Shapes within a Tensor-Product Higher-Order Space-Time Discontinuous-Galerkin Formulation,”** L. Diosady, S. Murman.
<http://arc.aiaa.org/doi/10.2514/6.2015-3044>
 - **“RANS Simulations of a Channel Flow with a New Velocity/Pressure-Gradient Model,”** S. Poroseva, J. Colmenares, S. Murman.
<http://arc.aiaa.org/doi/10.2514/6.2015-3067>
 - **“Mixing Layer: Numerical and Experimental Control Strategies,”** J. Little, U. Kaul.
<http://arc.aiaa.org/doi/10.2514/6.2015-3343>
 - **“Output-Based Adaptive Meshing Applied to Space Launch System Booster Separation Analysis,”** D. Dalle, S. Rogers. *
<http://arc.aiaa.org/doi/10.2514/6.2015-3152>



- **2015 AIAA Aviation and Aeronautics Forum (cont.)**
 - **“DSMC Study of Carbon Fiber Oxidation in Ablative Thermal Protection Systems,”** A. Borner, F. Panerai, N. Mansour.
<http://arc.aiaa.org/doi/10.2514/6.2015-3370>
 - **“A 3D Drag Optimization Study of Variable Camber Continuous Trailing Edge Flap (VCCTEF) Using OVERFLOW,”** U. Kaul, N. Nguyen.
<http://arc.aiaa.org/doi/abs/10.2514/6.2015-2422>
 - **“Advances in Distance-Based Hole Cuts on Overset Grids,”** W. Chan, S. Pandya.
<http://arc.aiaa.org/doi/10.2514/6.2015-3425>
- **“DNS of Flow in a Low Pressure Turbine Cascade Using Discontinuous-Galerkin Spectral-Element Method,”** A. Garai, presented at the ASME Turbo Expo, Montreal, Canada, June 15–19, 2015.
- **“On Subgrid-Scale Filtering in LES of Turbulent Flows with Shocks,”** D. Kotov, presented at the 9th International Symposium on Turbulence and Shear Flow Phenomena, Melbourne, Australia, June 30 – July 3, 2015.

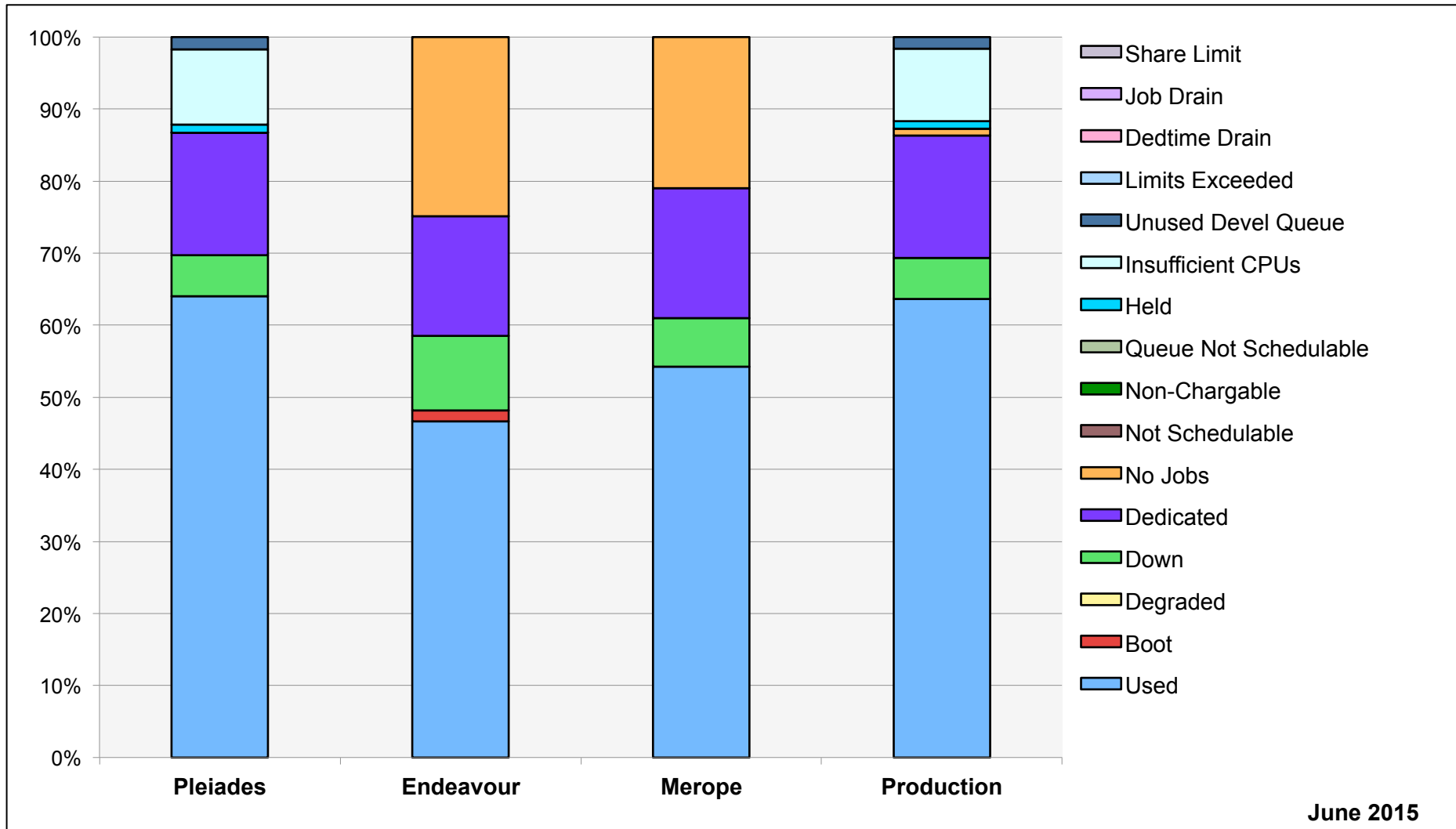


- **NASA Releases Detailed Global Climate Change Projections**, *NASA Press Release*, June 9, 2015—NASA has released data showing how temperature and rainfall patterns worldwide may change through the year 2100 because of growing concentrations of greenhouse gases in Earth’s atmosphere. The dataset is the latest product from the NASA Earth Exchange (NEX) big-data research platform, which uses HECC’s state-of-the-art supercomputing resources.
<http://www.nasa.gov/press-release/nasa-releases-detailed-global-climate-change-projections>
- **SC15 Selects Numerical Aerodynamic Simulation Program for Test of Time Award**, *HPCwire*, June 10, 2015—The Supercomputing Conference Test of Time Award committee has recognized the 1991 paper “The NAS Parallel Benchmarks—Summary and Preliminary Results” as an outstanding paper that has appeared at the SC conference and has deeply influenced the HPC discipline.
<http://www.hpcwire.com/off-the-wire/sc15-selects-numerical-aerodynamic-simulation-program-for-test-of-time-award/>
- **Unlocking the Mysteries of Space**, *HPCwire*, June 16, 2015—The NASA Advanced Supercomputing Facility features “hot Jupiter” magnetic field simulation done on the Pleiades supercomputer. (Also picked up by *SCOnline News*.)
<http://www.hpcwire.com/2015/06/16/simulations-unlock-the-mysteries-of-space/>
 - Taken from the NAS feature, “Simulating the Interior Dynamics of Stars and Giant Exoplanets.”
http://www.nas.nasa.gov/publications/articles/feature_hotjupiter_Rogers.html

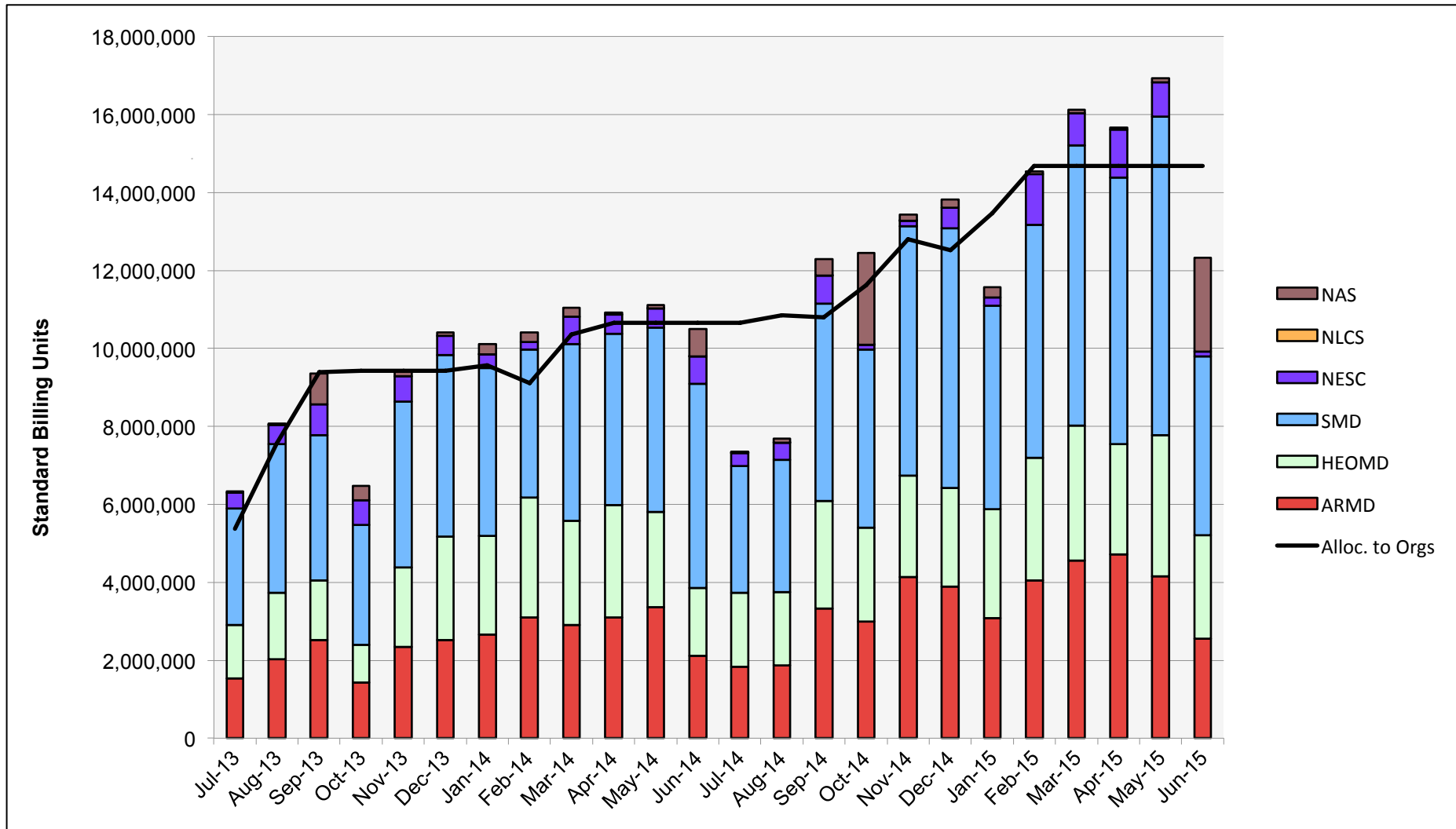


- **Computational Science and Data Visualization Take the Spotlight in New *Solar Superstorms* Documentary**, *National Center for Supercomputing Applications News*, June 29, 2015—A 24-minute, high resolution science documentary about the dynamics of the Sun debuts at the Louisiana Art & Science Museum before rolling out to more than a dozen planetariums and science centers around the world. Created by NCSA's Advanced Visualization Lab, the documentary uses data crunched on NCSA's Blue Waters and NASA's Pleiades and Discover supercomputers.
http://www.ncsa.illinois.edu/news/story/solar_superstorms
 - **NCSA Debuts “Solar Superstorms” Documentary**, *HPCwire*, June 30, 2015
<http://www.hpcwire.com/off-the-wire/ncsa-debuts-solar-superstorms-documentary/>
 - **Solar Superstorms Documentary Powered by Blue Waters**, *insideHPC*, June 30, 2015.
<http://insidehpc.com/2015/06/solar-superstorms-documentary-powered-by-blue-waters/>

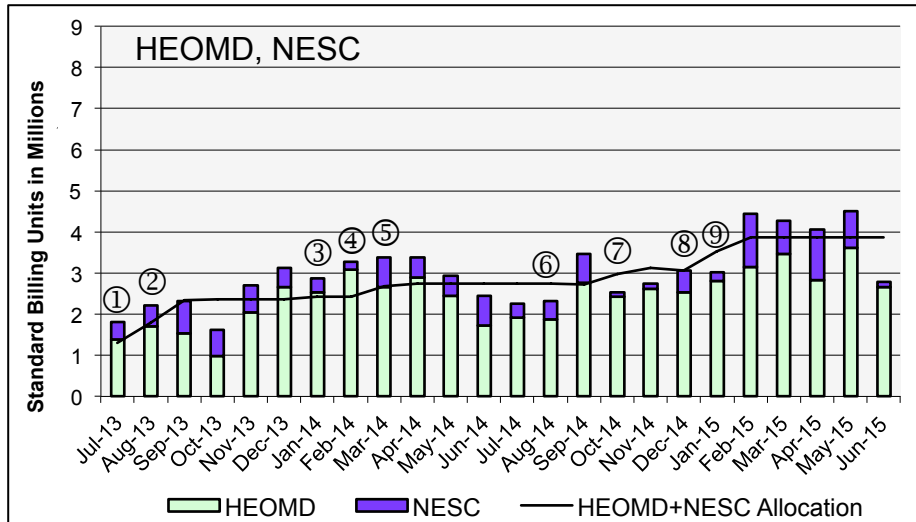
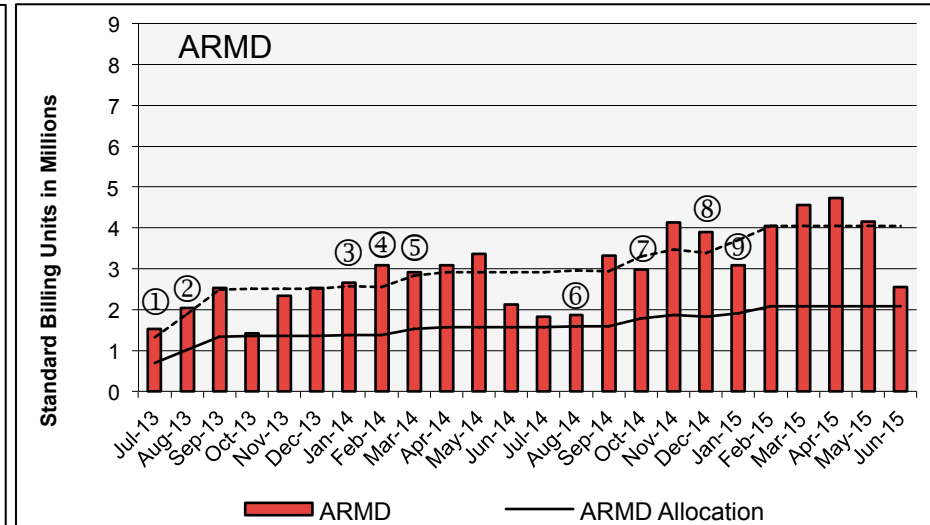
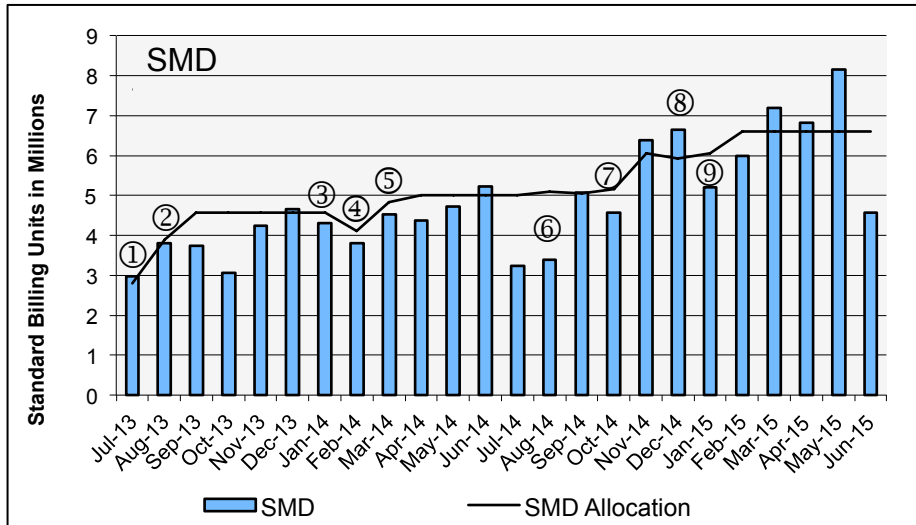
HECC Utilization



HECC Utilization Normalized to 30-Day Month

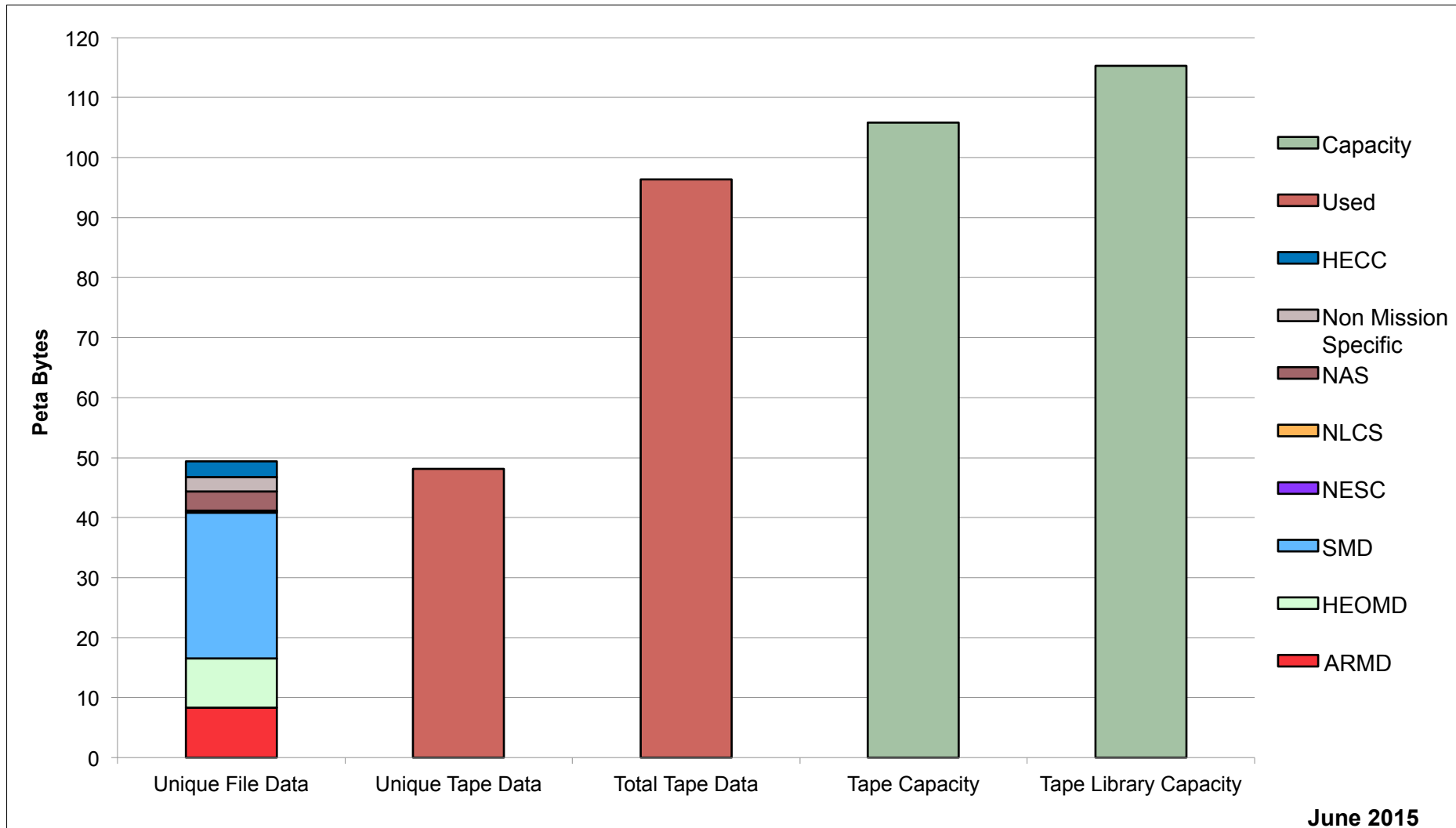


HECC Utilization Normalized to 30-Day Month



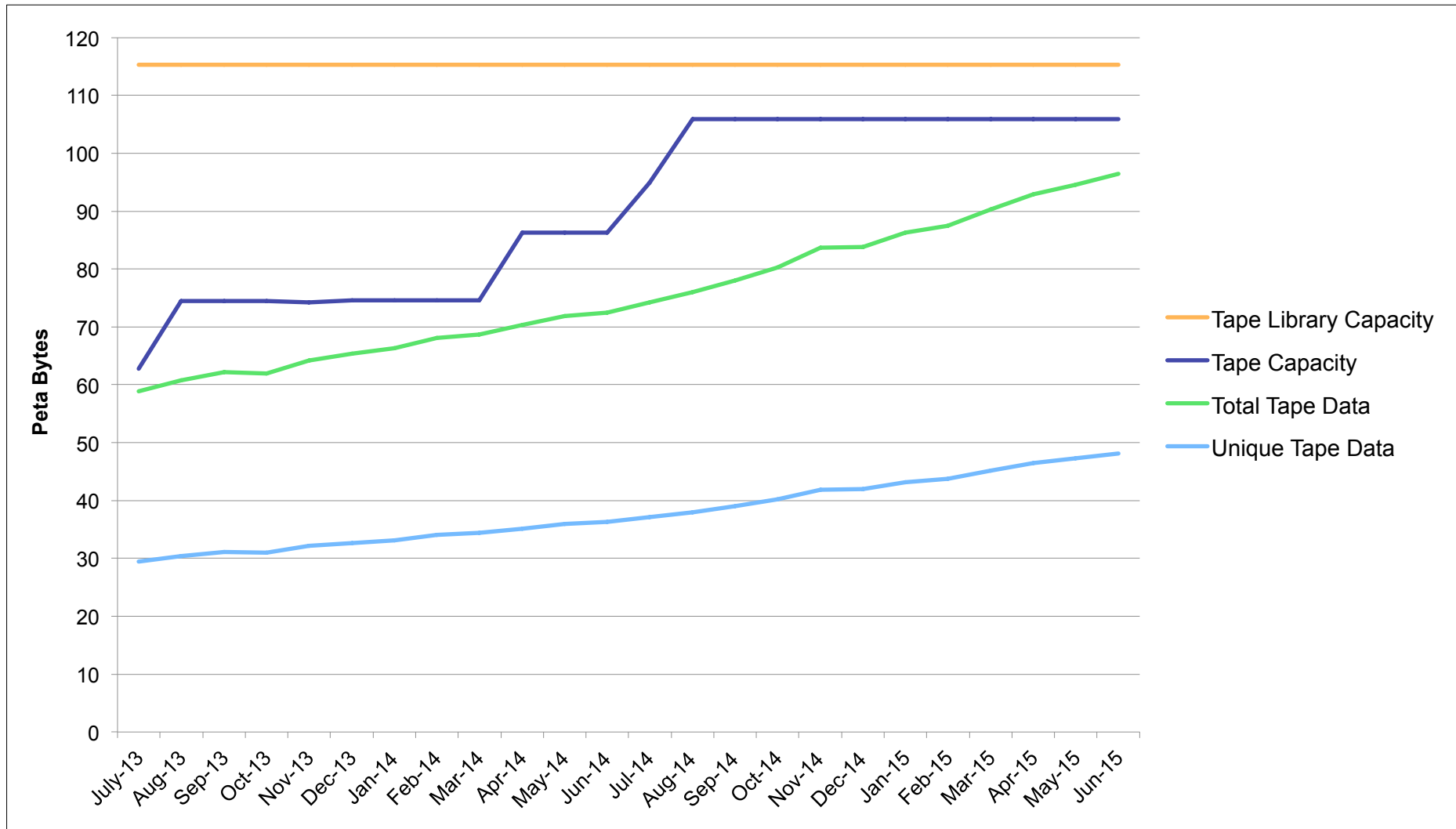
- ① 32 Harpertown Racks retired
- ② 32 Harpertown Racks retired; 46 Ivy Bridge Racks added
- ③ 6 Ivy Bridge Racks added; 20 Nehalem, 12 Westmere Racks Retired
- ④ 8 Ivy Bridge Racks added mid-Feb; 8 Ivy Bridge Racks added late Feb.
- ⑤ 4 Ivy Bridge Racks added mid-March
- ⑥ 6 Westmere Racks added to Merope, Merope Harpertown retired
- ⑦ 16 Westmere Racks retired; 10 Nehalem Racks and 2 Westmere Racks added to Merope; 3 Ivy Bridge Racks added; 15 Haswell Racks added
- ⑧ 16 Westmere Racks retired
- ⑨ 14 Haswell racks added

Tape Archive Status

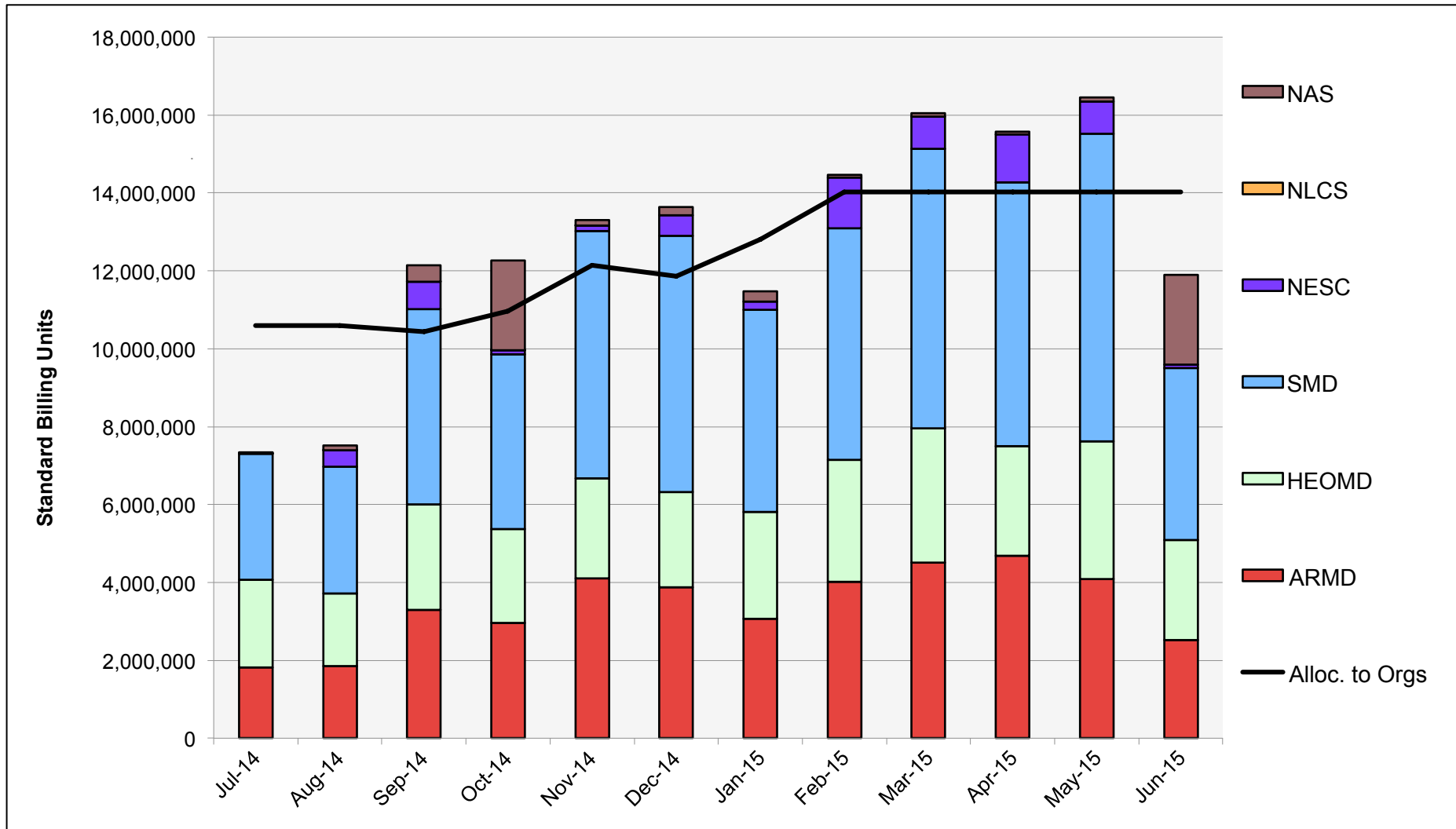


June 2015

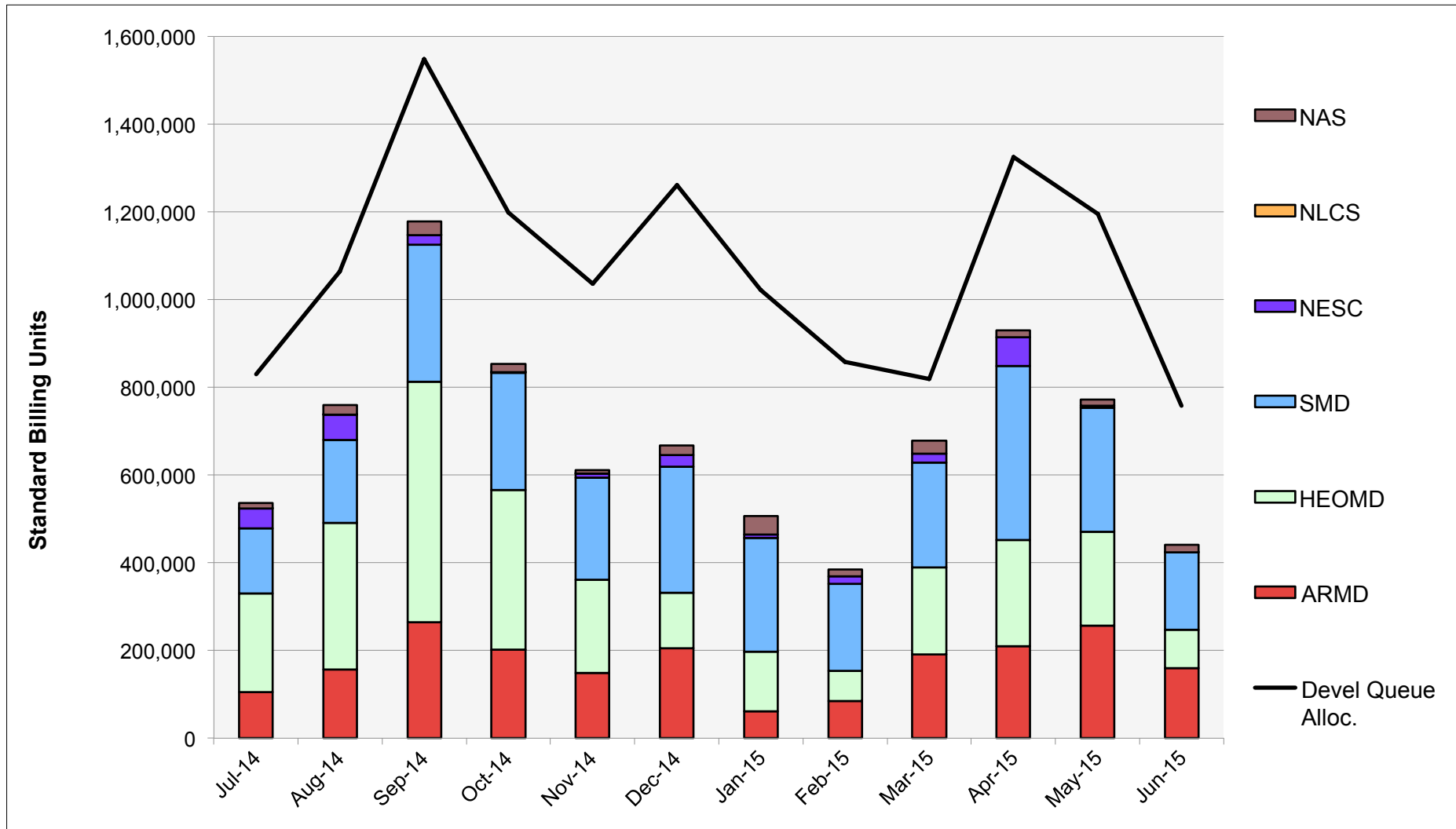
Tape Archive Status



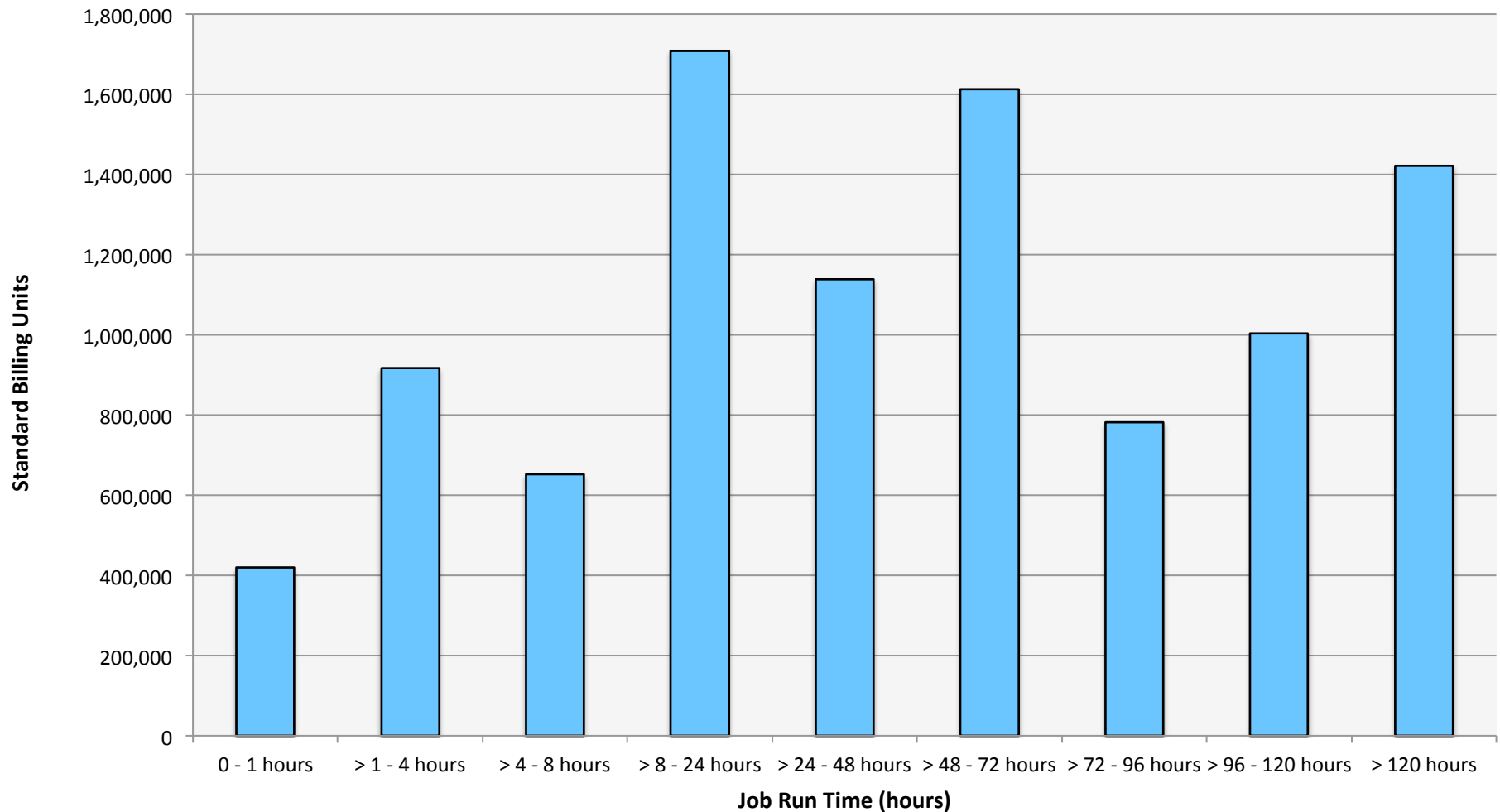
Pleiades: SBUs Reported, Normalized to 30-Day Month



Pleiades: Devel Queue Utilization

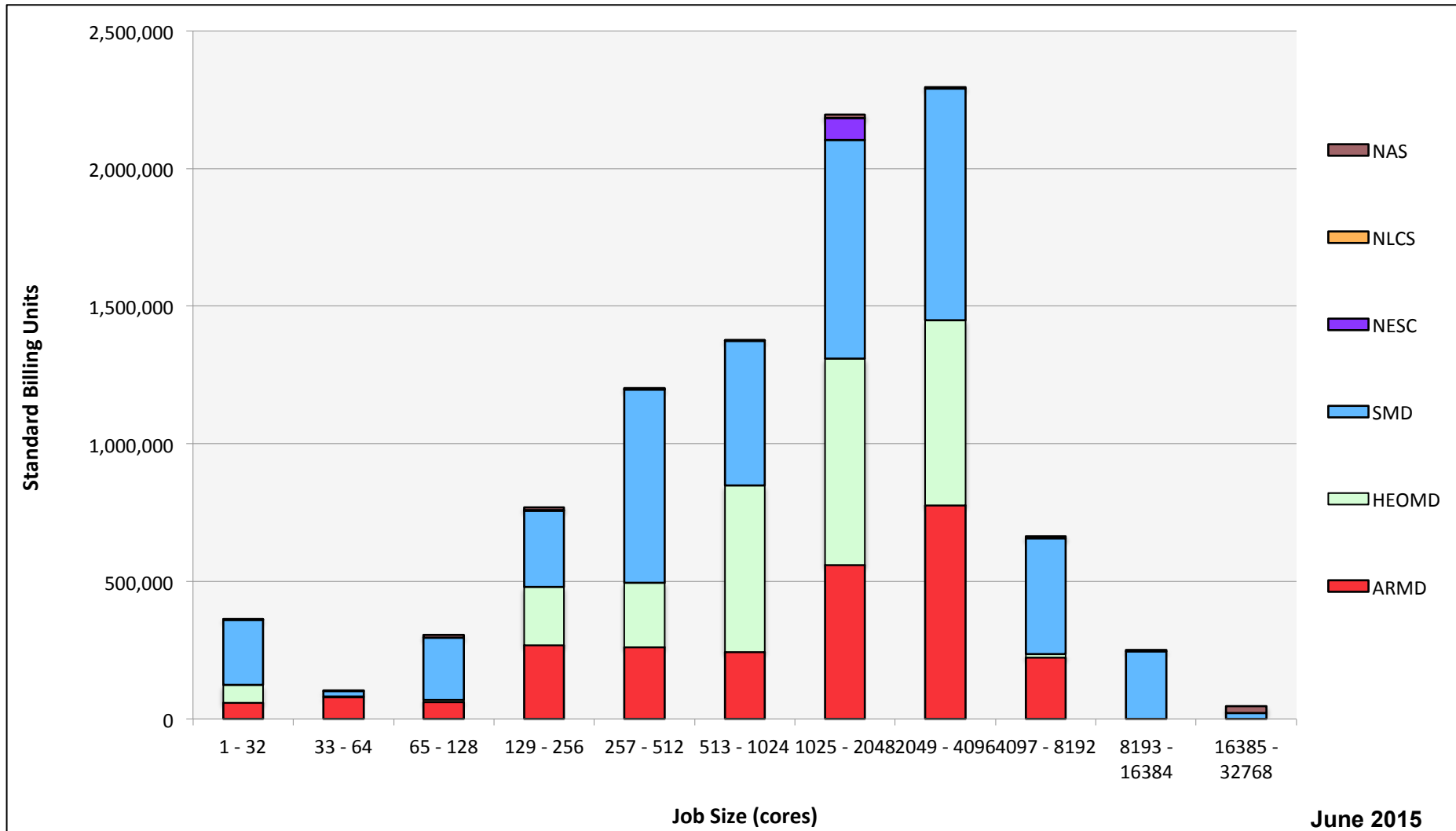


Pleiades: Monthly Utilization by Job Length

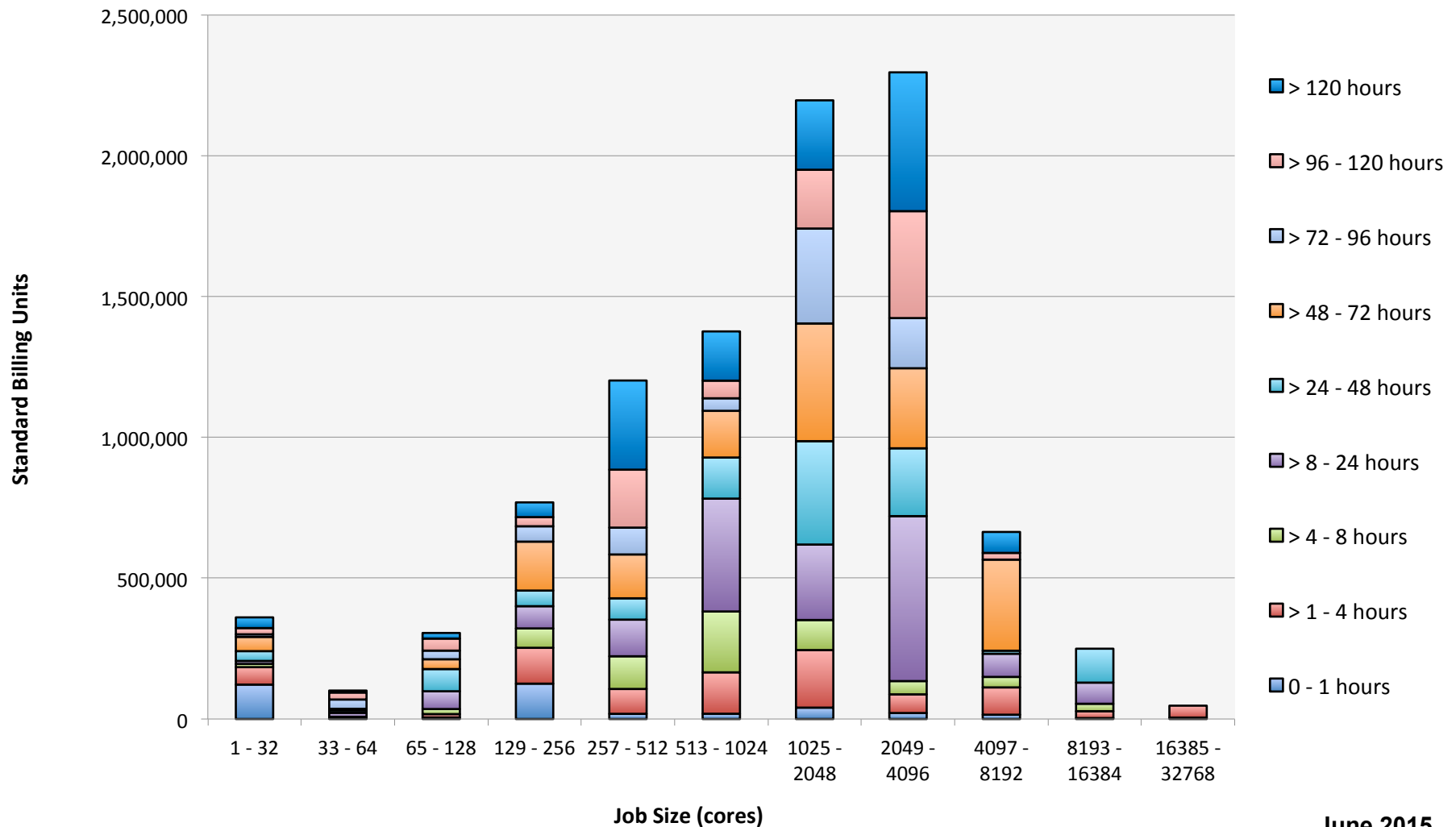


June 2015

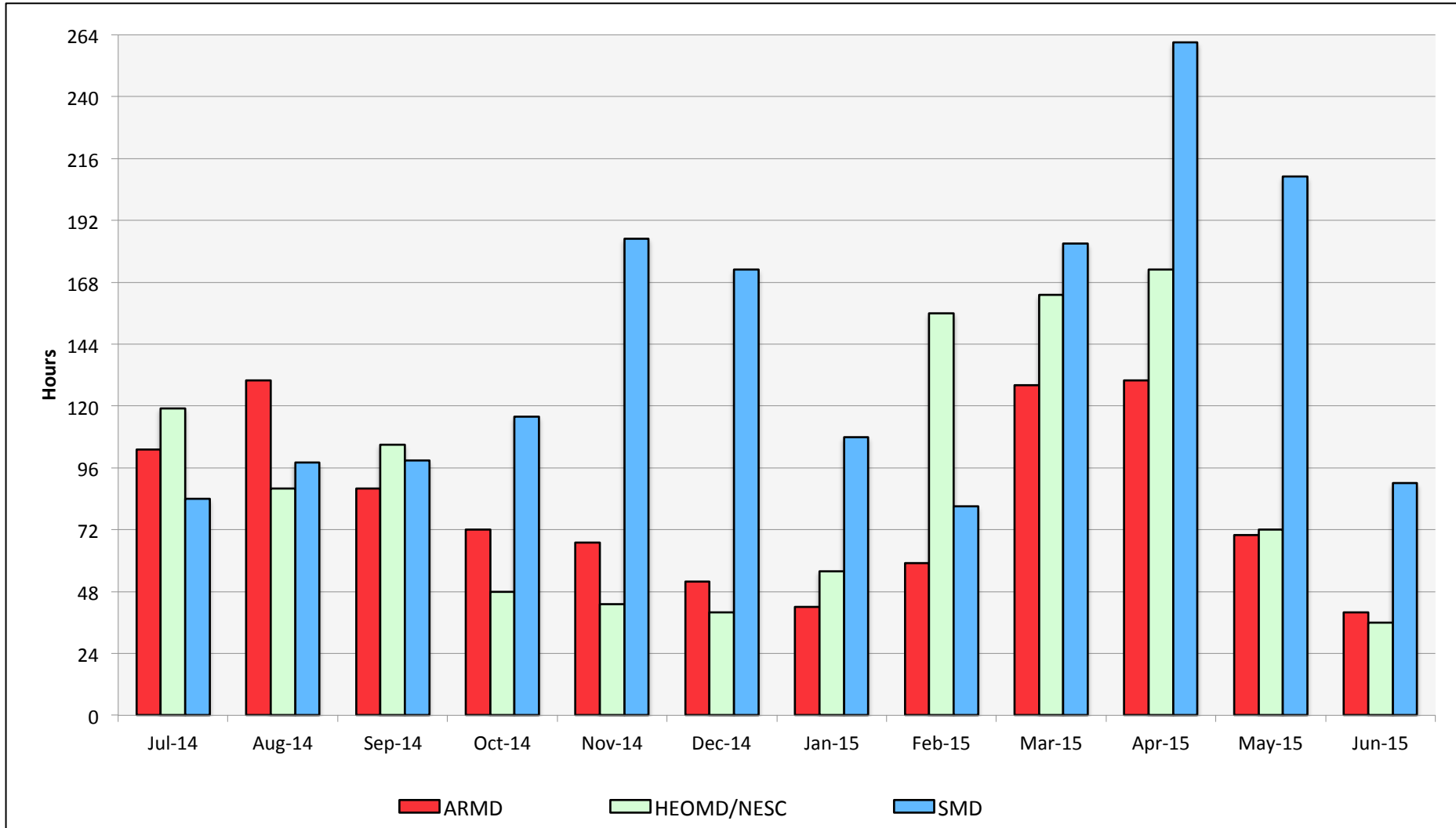
Pleiades: Monthly Utilization by Size and Mission



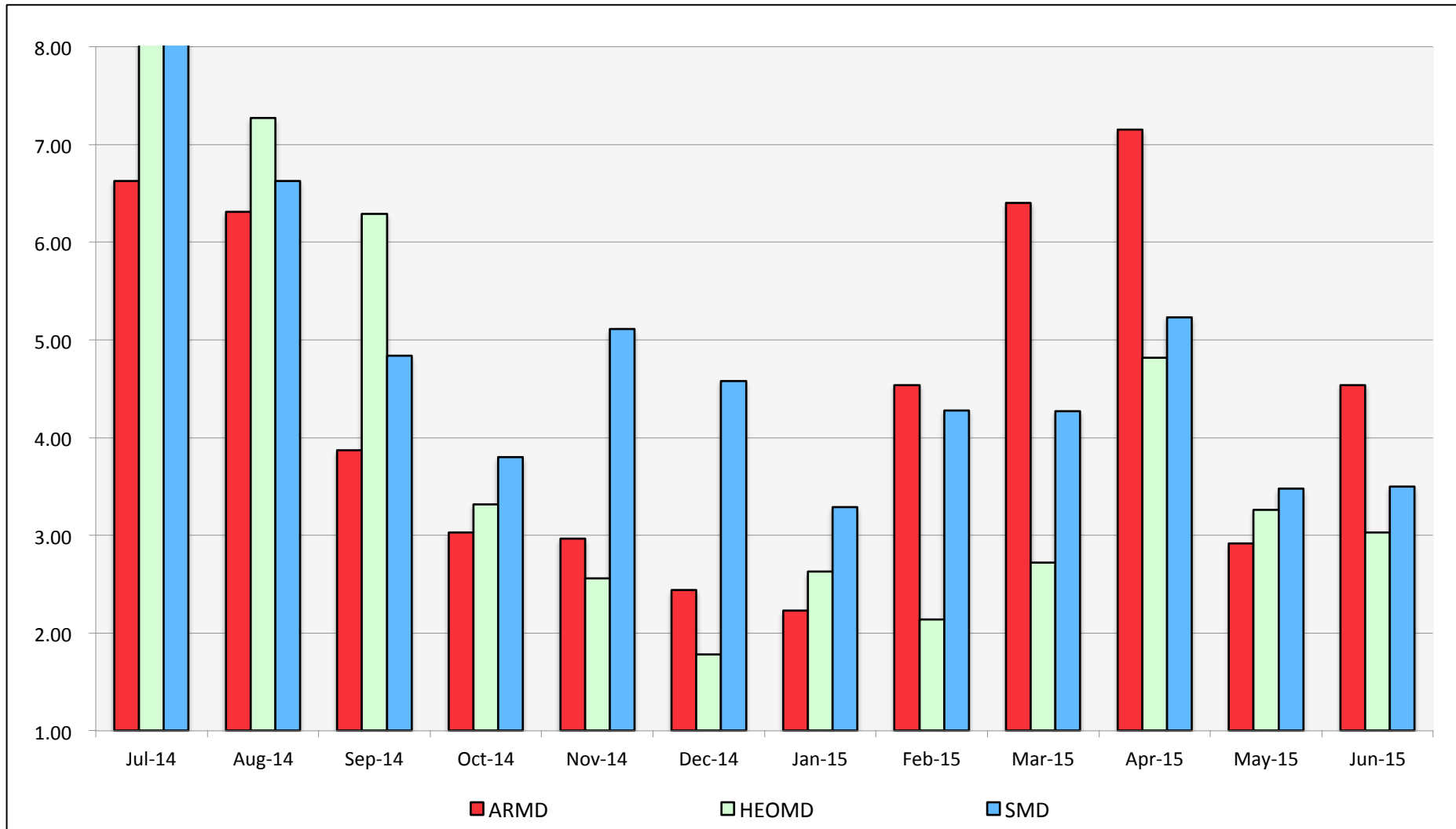
Pleiades: Monthly Utilization by Size and Length



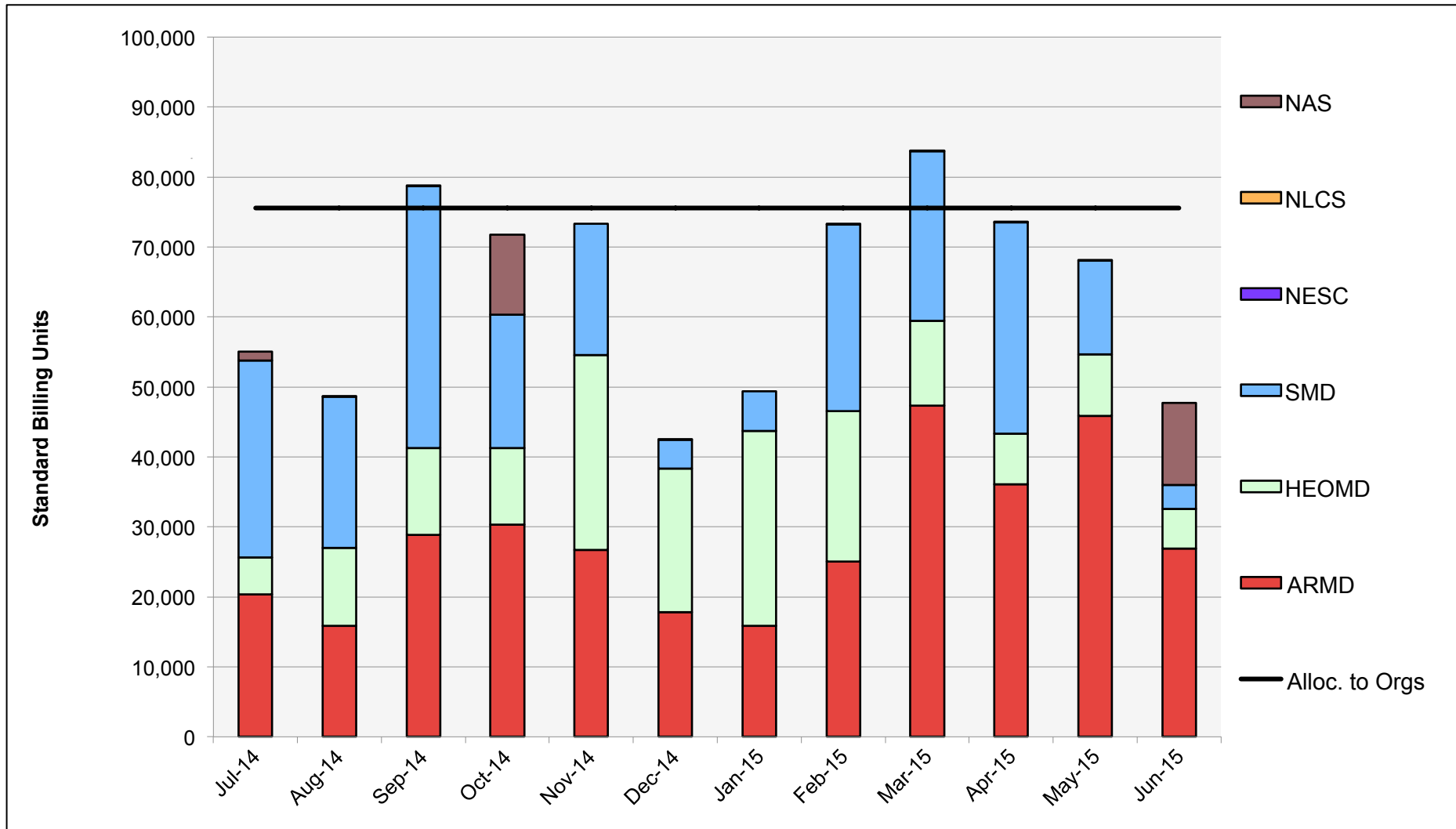
Pleiades: Average Time to Clear All Jobs



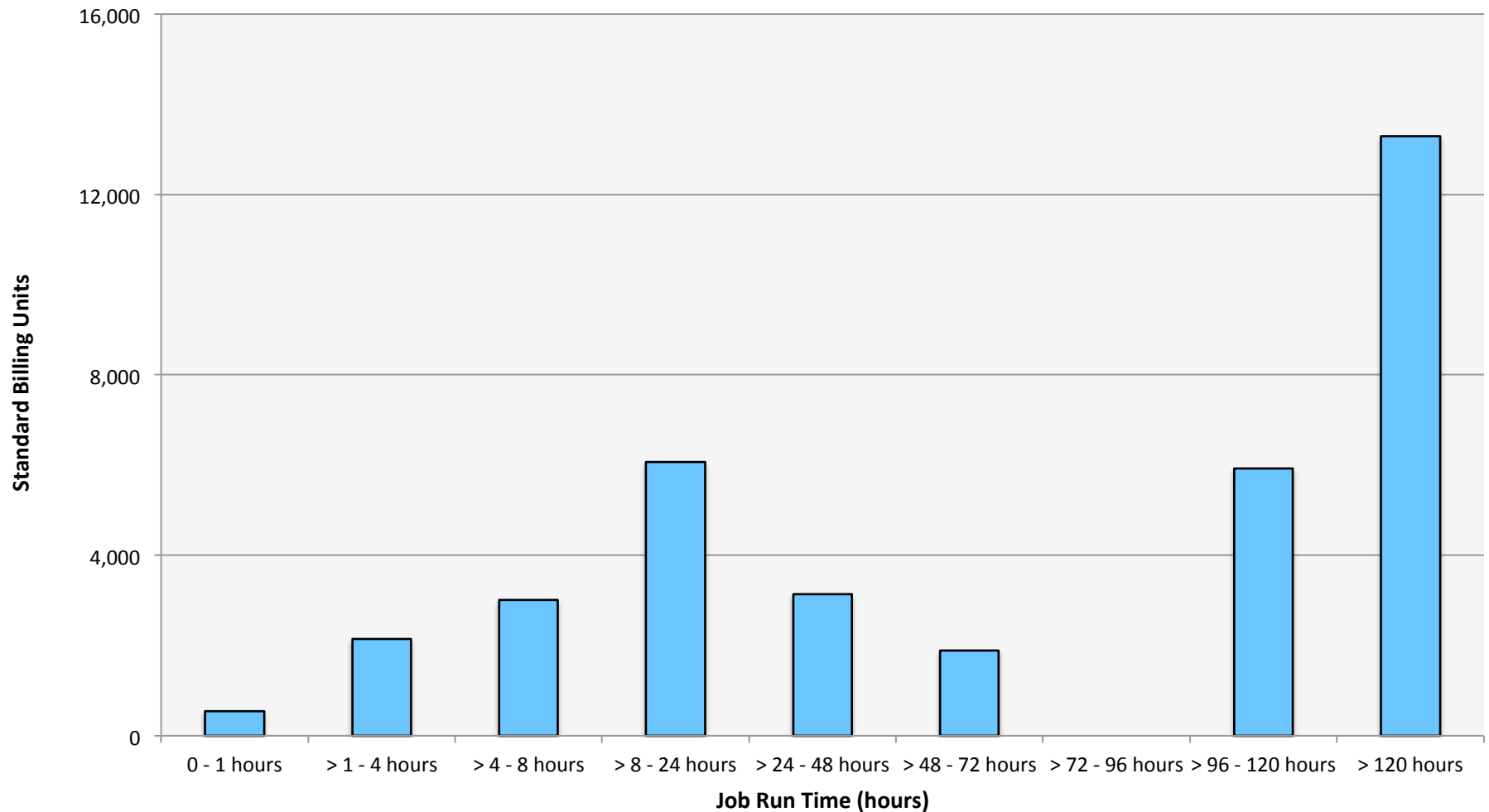
Pleiades: Average Expansion Factor



Endeavour: SBUs Reported, Normalized to 30-Day Month

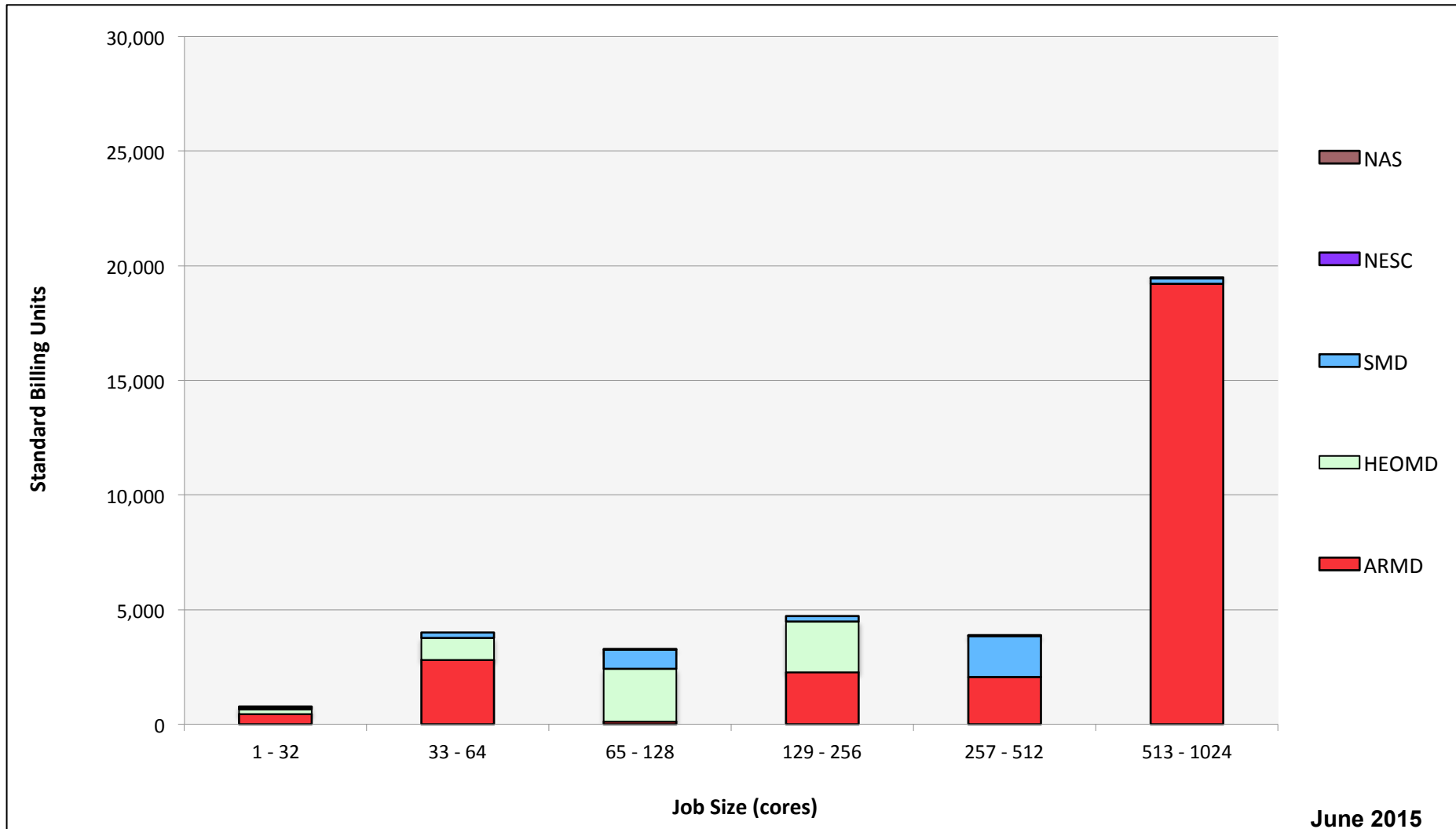


Endeavour: Monthly Utilization by Job Length



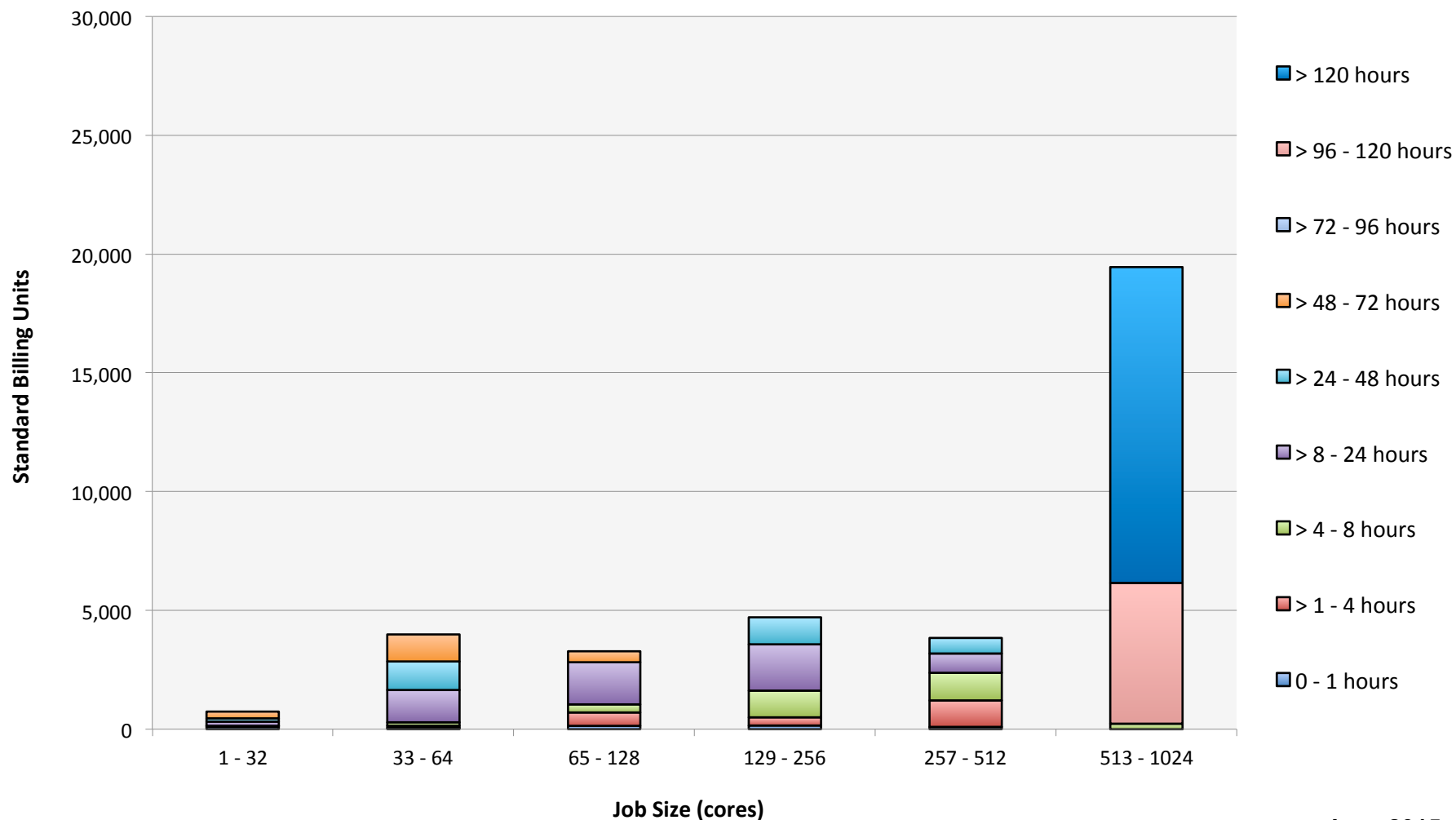
June 2015

Endeavour: Monthly Utilization by Size and Mission



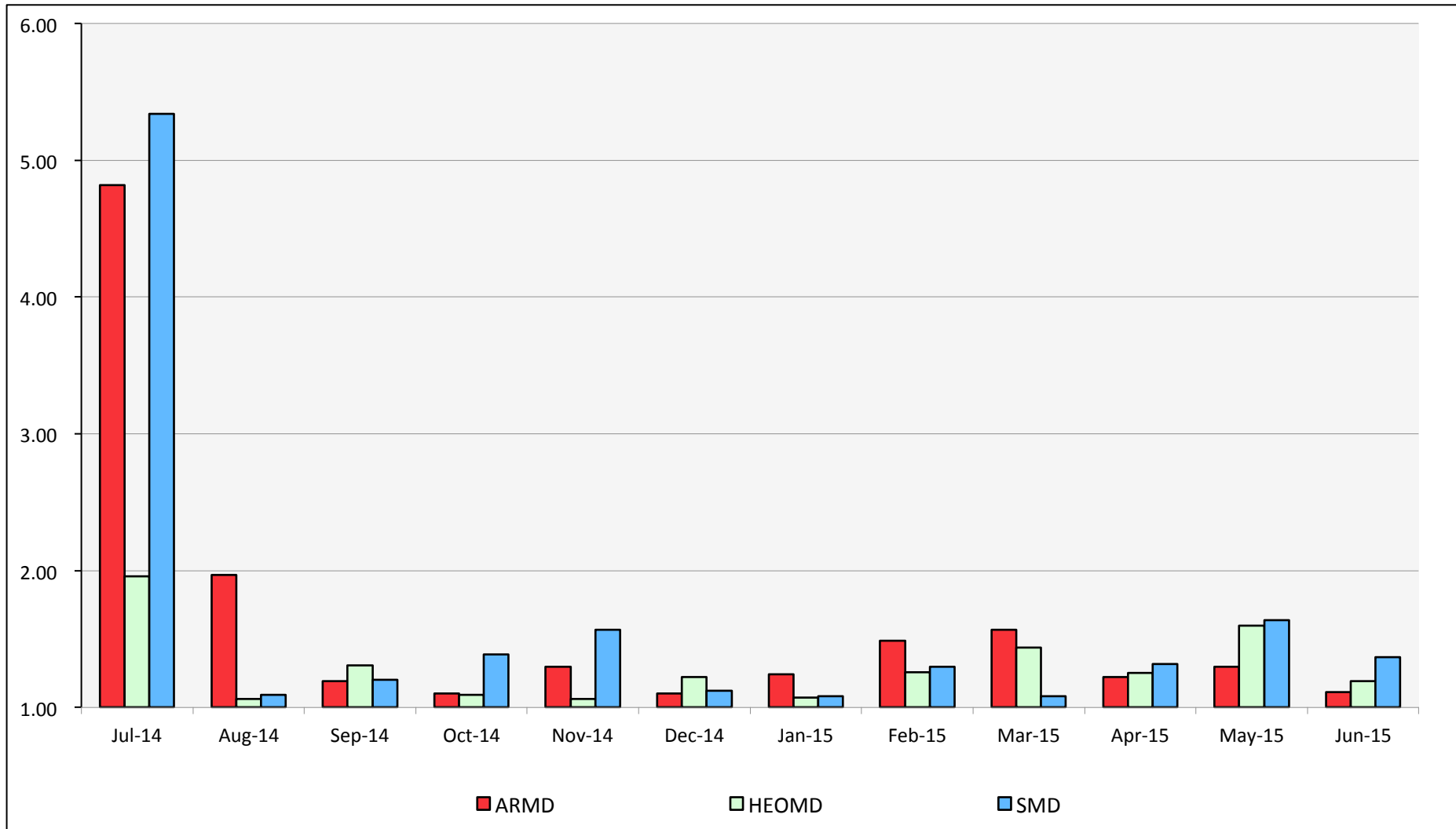
June 2015

Endeavour: Monthly Utilization by Size and Length

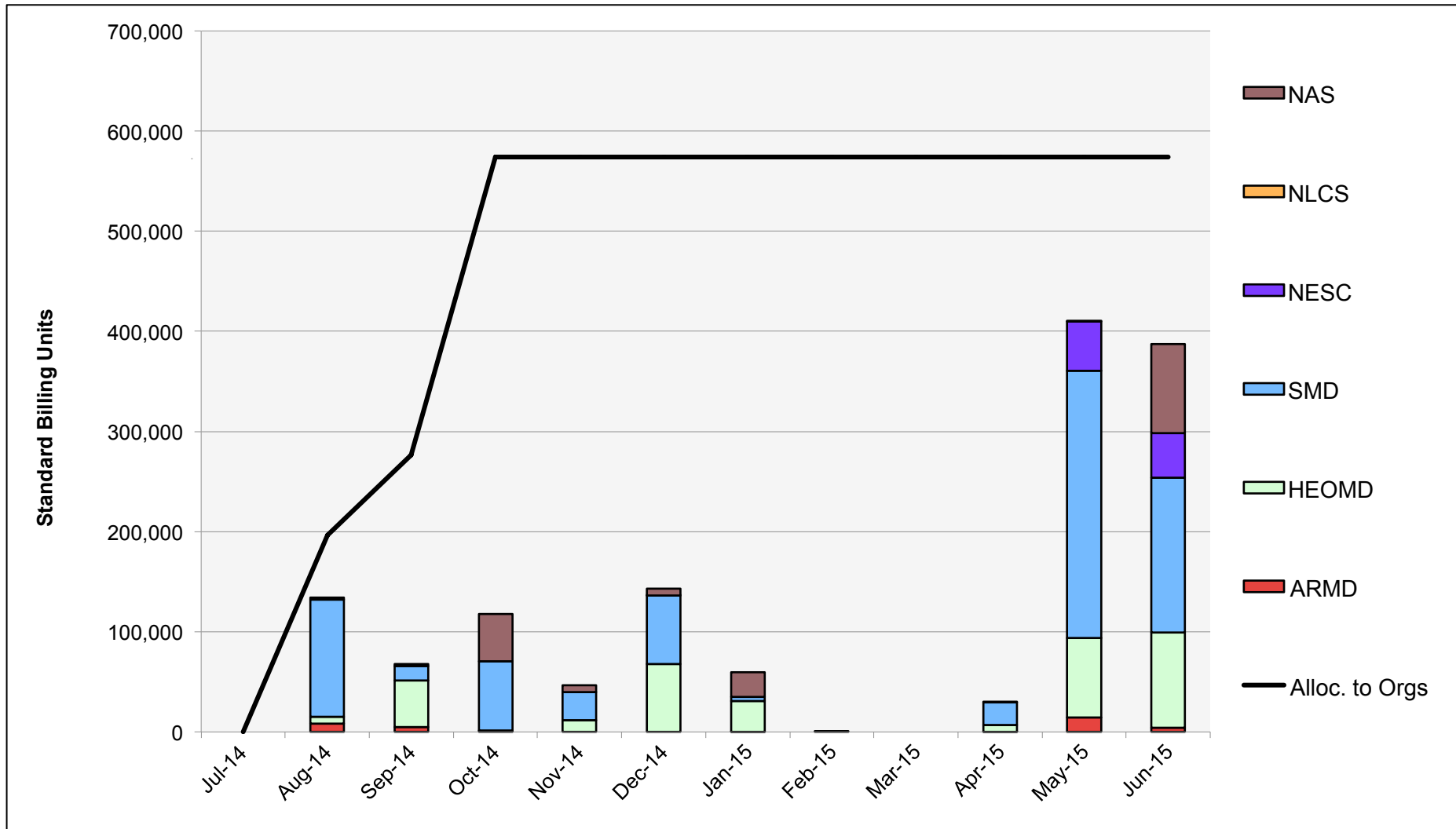


June 2015

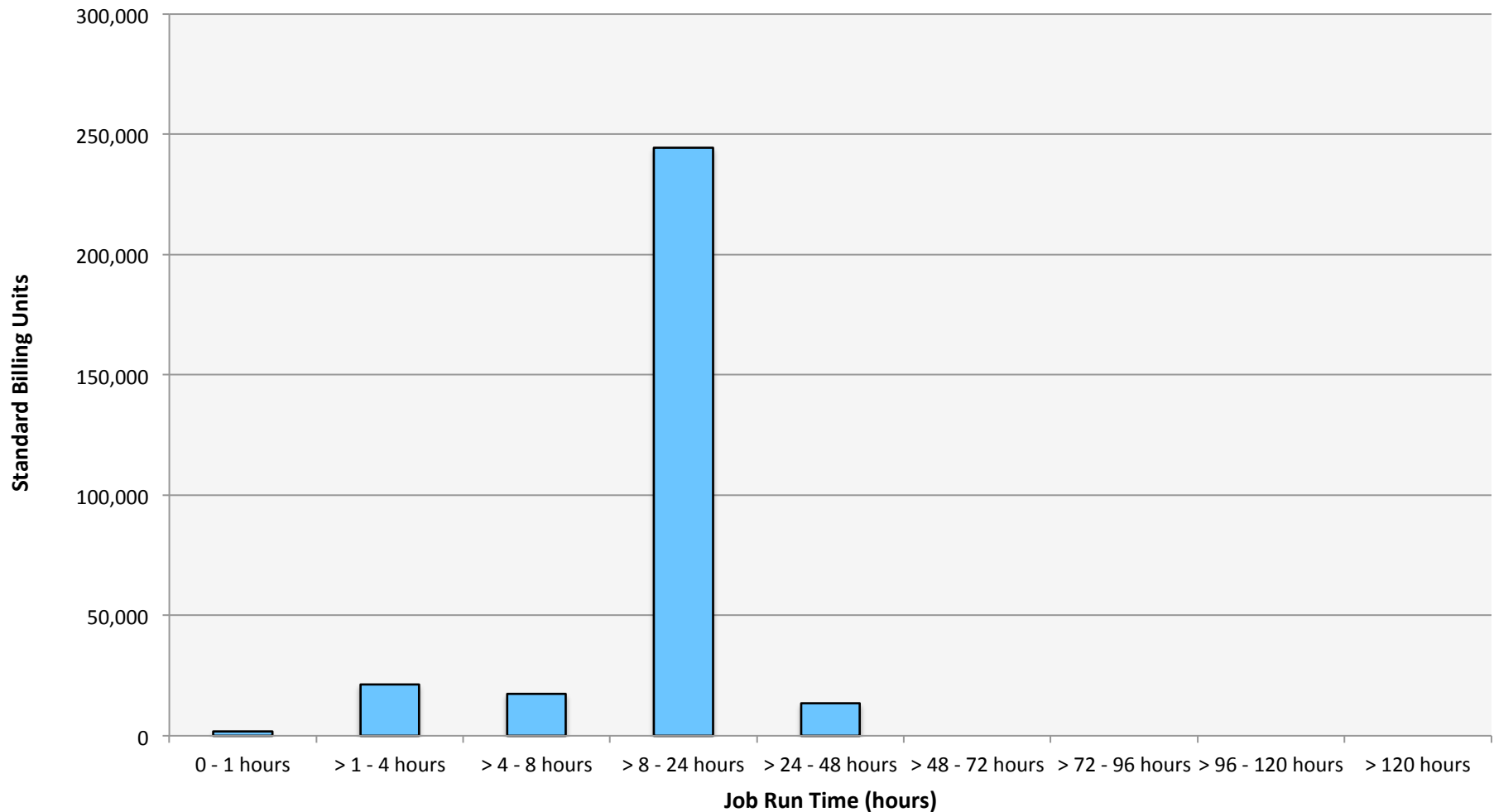
Endeavour: Average Expansion Factor



Merope: SBUs Reported, Normalized to 30-Day Month

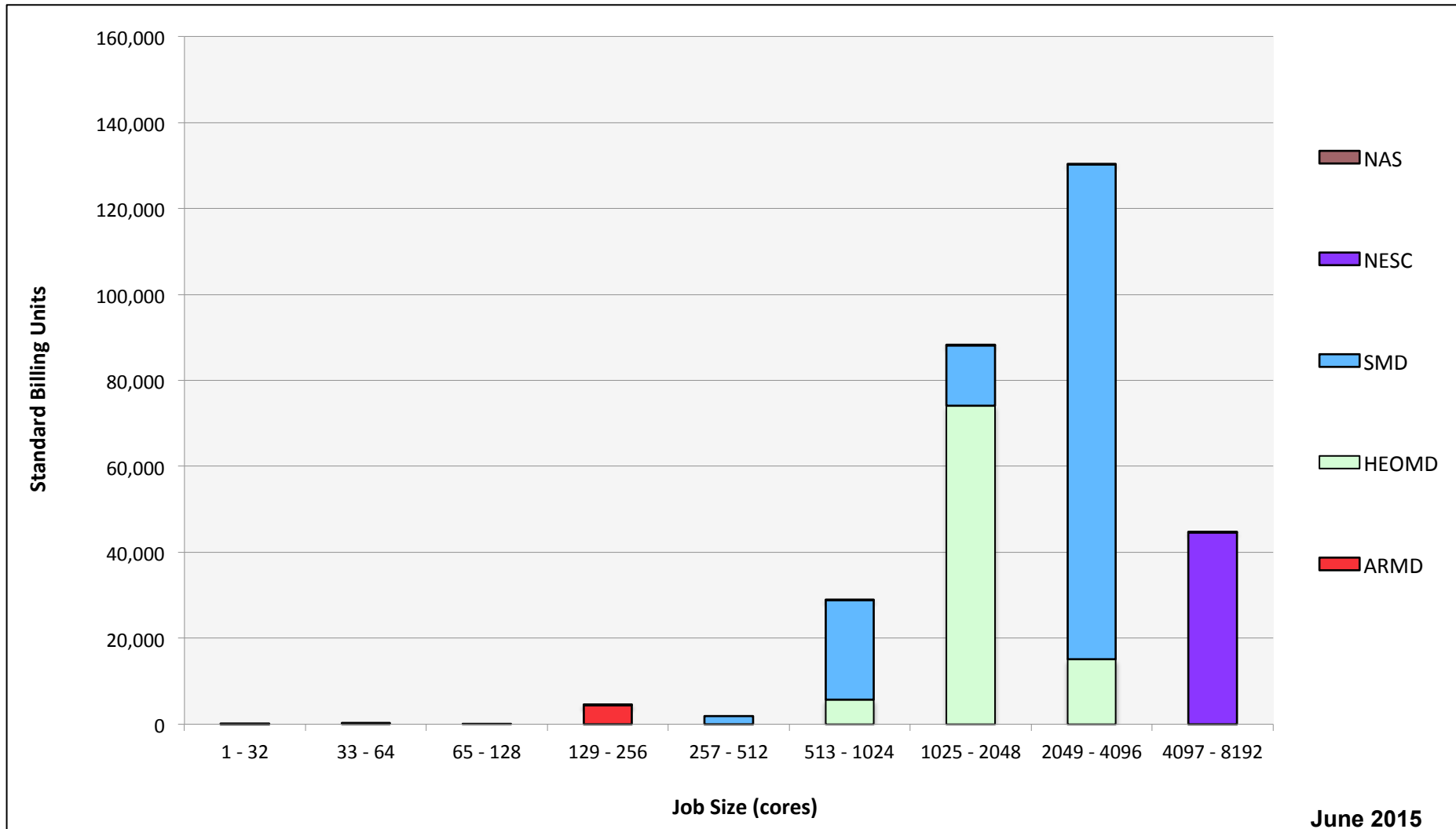


Merope: Monthly Utilization by Job Length

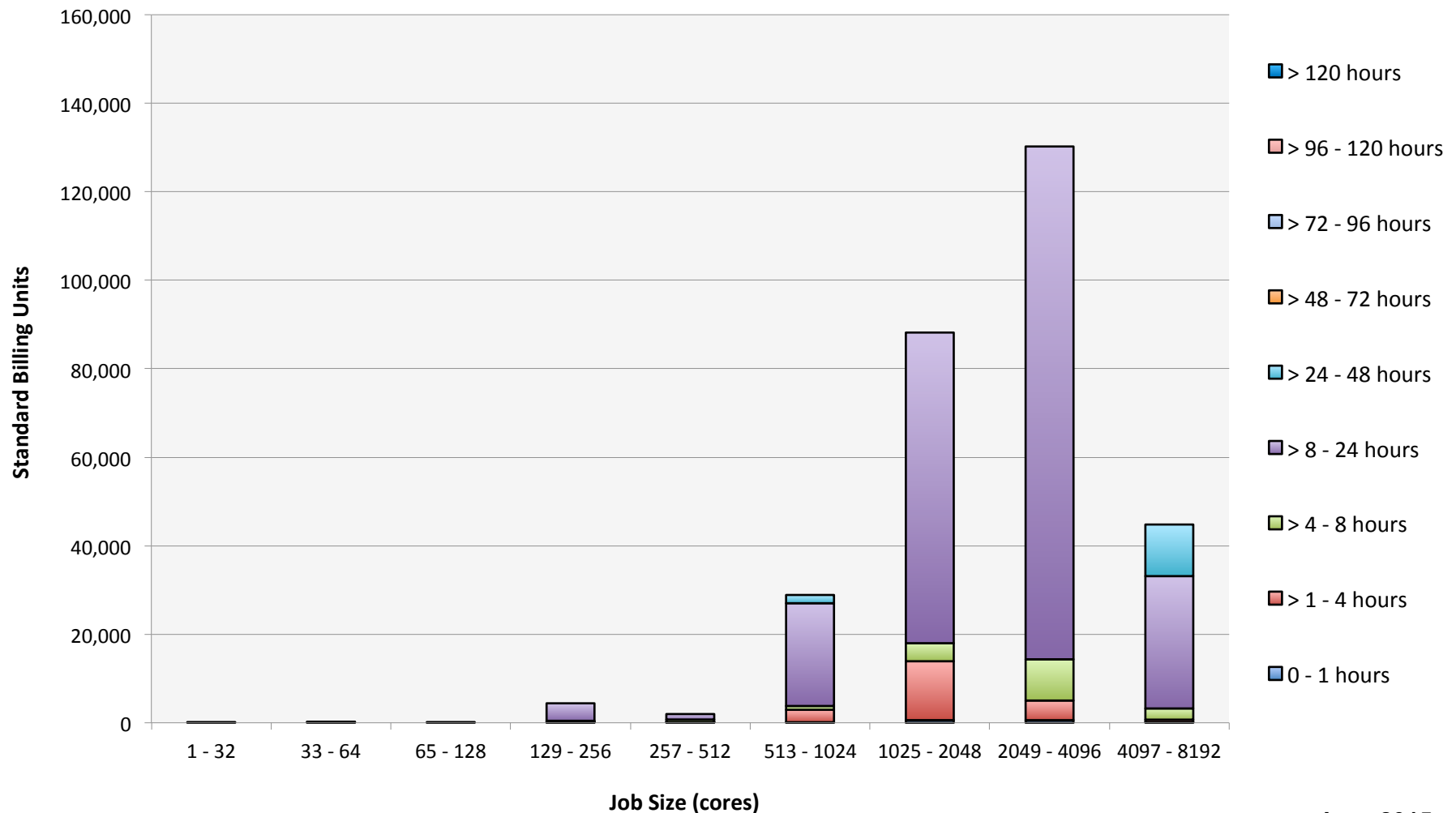


June 2015

Merope: Monthly Utilization by Size and Mission



Merope: Monthly Utilization by Size and Length



June 2015

Merope: Average Expansion Factor

